THE MODERN TREATMENT OF OCULAR IMBALANCES

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with the

GENOTHALMIC KRATOMETER

PRICE ONE DOLLAR

SHUR-ON STANDARD OPTICAL COMPANY, INC.
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THE MODERN TREATMENT OF OCULAR IMBALANCES

It was merely a question of the ostrich hiding its head in the sand when the pernicious advice was formerly given to correct the refractive error and let the extrinsic muscles "take care of themselves"; or the hazardous cutting and linking of the ocular muscles was advocated in the hope of making a balanced condition. Though the real issue was ignored, it never ceased to exist, for in every pair of binocularly functioning eyes there is a perfect or imperfect, normal or abnormal, comfortable or uncomfortable working arrangement between the intrinsic and extrinsic ocular muscles. Upon whether this synergistic relationship be a happy or an unhappy one depends the ocular comfort of the patient—and perhaps the ultimate welfare of the refractionist.

Unfortunately most of the work done toward solving muscular imbalance problems was directed along improper lines. The tests devised under this guidance tended to show faulty attachments, faulty verting powers, faulty tendencies, in brief, faulty structural conditions which, if they do exist, have little to do with Binocular Balance.

Now, thanks to Hazen's invention of the Kratometer and to Peckham's keen recognition of its broad possibilities and his development of a simple technique, we know that, with a very few exceptions, muscular imbalances are due to faulty innervational habits, or misdirected innervation.

Thus, the entire aspect of ocular muscle work has changed. Knowing the governing principle, it is now a relatively simple matter to uncover and remove the cause of muscular imbalances and to achieve comfortable Binocular Balance.

The instrument, and the only instrument, that enables us to do this work is the Genothalmic Kratometer.

Whether you believe in prisms in the position of rest, or in

innervational development, or in a wise admixture of these two systems, you will come to the Kratometer for the most comprehensive diagnosis and the most simple and effective means of applying developmental measures.

We have deemed it wise to give detailed instructions, however elementary they may seem, for making each test and for applying each corrective measure.

A superficial glance may cause such instructions to appear complicated; but attentive perusal will show that they are not only simple but outline definite methods of procedure that make it easy to use this instrument, even though one may have had no previous experience with it.

When everyone was in the same boat and all at sea so far as correcting muscular imbalances was concerned, that is, when everybody dodged the issue or used unsuccessful remedies, all were relatively safe. But the examiner who today ignores binocular imbalances is taking a desperate chance, and will find himself competing under great handicap with his more progressive confreres. Binocular imbalances have existed, do exist and will continue to exist and get more complex as living conditions get more complex and, willingly or unwillingly, they must be met. The Genothalmic Kratometer affords the simplest and most secure way out.

THE PURPOSE OF THE GENOTHALMIC KRATOMETER

The Genothalmic Kratometer fills a demand for an instrument, the necessity for which has been recognized for over three decades, that will enable the refractionist to properly care for the many anomalous cases of eye strain that are not relieved by the prescription of glasses. The instrument is the result of many years of study and research, and has been designed to afford a means for caring for the idiosyncracies presented in multitudinous variety in these peculiar cases.

Exercises with the Kratometer offer a successful method of treating the cause of those defects of ocular motility that produce eye strain, uncomfortable vision, poor vision, lack of equilibrium, indigestion, headaches, slow focussing, and many other complaints.

Specifically, Kratometer exercises are to be given for:

The cultivation in the nervous centers of proper habits of distribution of innervational and inhibitory impulses in cases of troublesome heterophorias.

The breaking down of unwanted association between convergence and accommodation and the development of the convergence relaxation in accommodative esophoria.

The breaking down of unwanted association between convergence and accommodation and the development of accommodative relaxation in accommodative, or pseudo, myopia.

The development of equality of vertical ductions in hyperphoria.

The training of the secondary visual centers in suspenopsia.

The development of binocular adjustments to overcome the possibility of monocular suppression.

The education of the fusional sense and the desire for single binocular vision.

The development of a wide-angle field of single binocular vision with proper accommodative association.

Development of convergence and accommodative amplitudes.

Education of the various functions used in near vision, when several hours of near work cannot be carried on without fatigue.

Development of "speed of vision" and "speed of adjustment" for motorists, typists, etc.

Development of visual acuity in amblyopia ex anopsia.

Development of the fusional sense in certain types of exotropia and esotropia.

Education of the sense of stereoscopic vision, when this is lacking.

The correction, without glasses, of "sub-normal accommodation," or "premature presbyopia," in children and young people, when this apparent error is not structural but innervational.

The education of proper associative habits between convergence and accommodation, when this development has been retarded in the individual's growth.

The restoration of binocular functions when these have been lost during the progress of some febrile or toxic disease.

The development of ocular motility when ductions in all directions are sub-normal.

The establishment of well-traveled neuro-muscular reflex paths when, for any cause, their development has been incomplete.

The ability to maintain, without fatigue, concentrated binocular fixation on one point. Fatigue at the "movies" is due to lack of this ability. In many forms of industrial work this ability is absolutely essential, and the productive capacity of the individual is lowered by lack of it. Motor driving

calls for this ability, in addition to swift binocular motility.

The removal of those inadequacies of binocular functioning that lead to dizziness, car-sickness, indigestion and nervous exhaustion.

The development of the sense of ocular orientation which includes speed of binocular fixation and the maintenance of equilibrium.

The development of nervous conductivity to a maximum of "increment" with the minimum of "decrement."

The development of muscular "tone" and good health, ease and certainty of contractility and relaxation, with the ability to function without fatigue.

The education in co-ordination of all functions of binocular vision that the individual may become possessed of those advantages normally inherent in the faculty of human vision.

As a diagnostic instrument, the Genothalmic Kratometer enables the refractionist to discover the real underlying causes productive of visual discomfort in many of the obscure cases that have hitherto proved so baffling.

With the Kratometer, it is possible to disclose the full hyperopic error, without the use of atropine, by mechanical relaxation of convergence and inhibition of its control over accommodation.

Relation of convergence to accommodation and the influence of the former over the latter can be determined.

Causes of stress can be revealed and eradicated.

Structural and innervational error may be definitely differentiated.

THE GENOTHALMIC KRATOMETER PRINCIPLE

KRATOMETER duction tests and prismatic exercises are based on the physiologic fact that the retinal area whose irritation induces versions, convergence and fusion is in the field

surrounding the macula, and not in the macula itself. The sense of diplopia aroused in this peripheral field awakens the fusional sense, bringing about the reflex muscular stimulations that lead to macular fixation and fusion.

In reading the printed page, in watching the flight of an aeroplane, in vigilant attention to the road ahead of the speeding automobile, in viewing the passage of hundreds of objects that fly past the window of a moving train, the eyes do not turn in a steady, unbroken movement, but in a series of jumps and minute readjustments, following each other in rapid succession. These jumps are instigated by the passage of the moving object off the macula into the fields immediately surrounding, and the consequent report to the central nervous system of slight diplopias. The reflex of these diplopia sensations is the quick readjustment of the eye positions to macular perception and fusion.

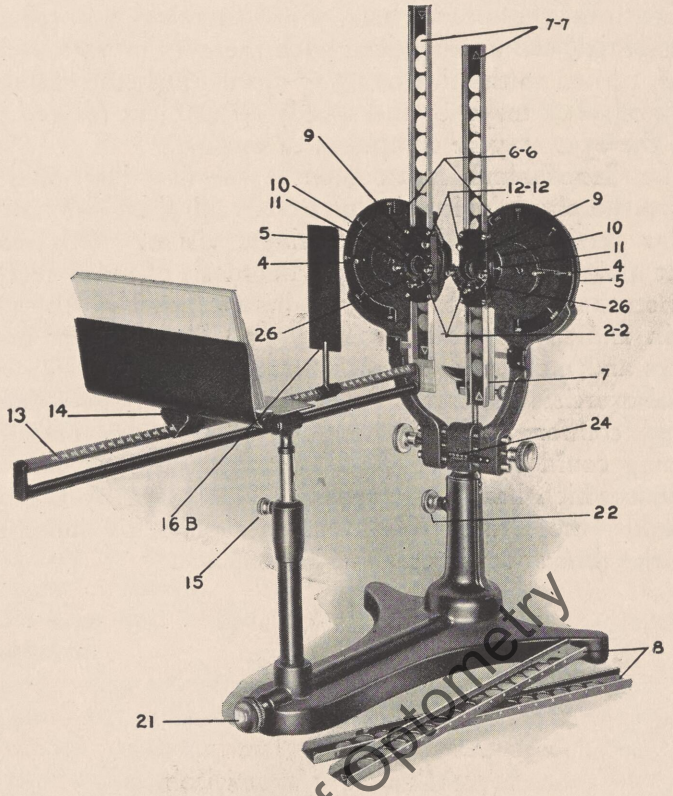
The "pulling power of the muscles," which is measured by all devices heretofore invented for the measurement of ductions, is of far less importance than the quick adjusting or "jumping" reflexes. Innervational responsiveness is the desideratum, and "muscular strength" becomes of secondary importance.

In the Kratometer prism movements, the images are "jumped" out of fusion, awakening the fusional impulse and reflexes by a sudden stroke. This "jump," repeated time and time again, each repetition causing reflex activity, establishes the desired habit.

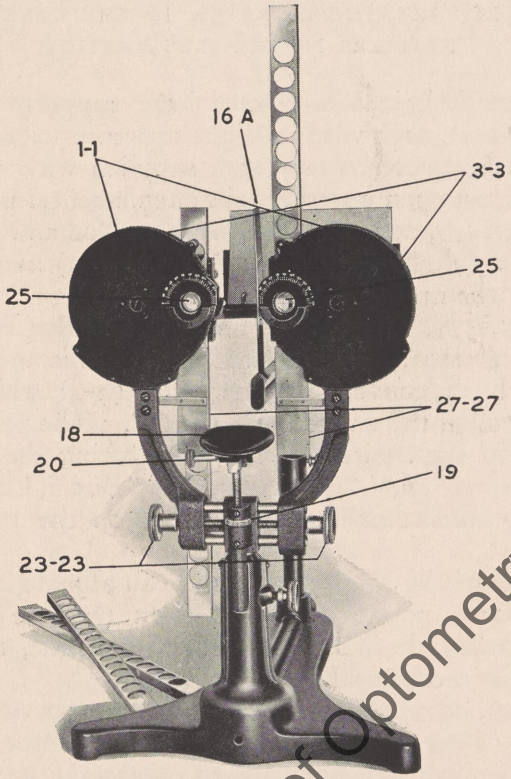
Stimulation of the primary, or retinal, and secondary, or cortical, visual centers, and the establishment of frequently traveled nervous routes between them, increases visual acuity. Thus, Kratometer exercises develop both acuity and fusional habits simultaneously, and become of particular value in the development of vision and co-ordination with its mate of an amblyopic eye, to which clear vision and the sense of binocularity are unknown.

The adjustments of the Genothalmic Kratometer are so devised that these reflex acts, whose certainty and speed are so essential, can be practised with the eyes in various positions, turned to the side or up or down, thus cultivating the habit of quick response and speedy adjustment for any position the eyes may be compelled to assume.

The Genothalmic Kratometer is the first instrument to utilize the physiologic principles controlling the functions of ocular versions and binocular single vision. This instrument makes possible the correct diagnosis of many puzzling phenomena leading to ocular imbalance and strain, whose origin and interpretation were impossible by older instruments and methods. The Kratometer methods of innervational exercising successfully correct many of these defects, giving comfort to many sufferers for whom previously nothing could be done. And in those milder forms of imbalance which have been successfully treated by the older methods, the Kratometer methods shorten by more than half the time spent in establishing balance.



2-2, Slight Apertures. 4-4, Axis Latch. 5-5, Prism Base Recording Scale.
6-6, Openings for Registering Rotary Disk Auxiliary. 7-7, Vertical Prism Slides.
8-8, Horizontal Prism Slides. 9-9, Prism Slide Adjustable Brackets.
10-10, Openings for Registering Prism Power. 11-11, White Prism Slide Markers.
12-12, Bracket Set Screws. 13, Test Chart Carrier Rod 14, Test Chart Carrier.
15, Test Chart Carrier Rod Set Screw. 16-B, Stereoscope Septum in Use.
21, Screw for Raising and Lowering Batteries. 22, Screw for Locking Batteries.
24, Pupillary Scale. 26, Three Front Lens Cells.



1-1, Main Batteries. 3-3, Knurled Edges of Rotary Disks.
16-A, Stereoscope Septum Not in Use. 18, Chin Rest.
19, Knurled Nut for Adjusting Chin Rest. 20, Chin Rest Set Screw.
23-23, Pupillary Adjustment Knobs. 25, Three Rear Lens Cells.
27-27, Breath Shields.

DESCRIPTION OF THE GENOTHALMIC KRATOMETER

NUMBERS IN PARENTHESES REFER TO THE CORRESPONDING NUMBERS IN THE ILLUSTRATION

THE Genothalmic Kratometer base supports two main batteries (1–1), each with its sight aperture (2–2). In each battery is a circular rotary disk supplied with nine auxiliaries, viz., an open aperture, six supplemental prisms, 3△, 5△, 10△, 15△, 20△, 25△, a Maddox Rod and a red glass. These rotary disks have knurled edges (3–3) and are easily turned by the finger against these edges.

The 3△, 5△, 10△ prisms and the Maddox Rod can be rotated and set at any desired axis. This movement is operated by a convenient axis latch (4–4) which can be turned through the entire circle of 360°. The prism base is thrown into the desired position by setting the axis latch over the word "In," "Out," "Up" or "Down," as found on the prism base recording scale (5–5) on the front of the battery.

The axes of the Maddox Rods are so adjusted that when the axis latch points at up or down the line of light is vertical; when the axis latch is at in or out, the line of light appears horizontal.

The 15△, 20△ and 25△ prisms are always at base out, regardless of the position of the axis latch, since this is the only position in which such strong prisms can be used.

In an opening (6–6) near the top of each battery, and in plain view from the operator's position, is registered the auxiliary from the rotary disk that is in position in the sight aperture.

Four prism slides are provided with the instrument, two with horizontal prisms (8–8) and two with vertical prisms (7–7).

Each of the bars with horizontal prisms contains an open

aperture succeeded by prisms from 1△ to 13△ in 1△ intervals. An open aperture also succeeds the 13△ prism. Together with the supplemental prisms from the rotary disks, any base IN power from 1△ to 46△, and any base OUT power from 1.△ to 76△, can be quickly obtained.

Each of the prism slides with vertical prisms contains an open aperture followed by prisms from 0.25△ to 3.25△ in 0.25△ steps. In combination with the supplemental prisms from the rotary disk any desired prism power base up or base down, in quarter-diopter graduations are at quick command. An open aperture in the slide succeeds the 3.25△ prism.

The prism powers are engraved on the sides of the prism slides. The position of the prism base and apex is indicated by a △ engraved on the front of the prism slide.

The prism slides are to be inserted in the adjustable brackets (9-9). The slides are held securely in place by pawls that engage in notches in the slides.

The prism power from the slide that is before the sight aperture can be noted by the operator in a convenient registry opening (10-10) in the outer side of the adjustable bracket.

The adjustable brackets, carrying the prism slides, can be angled through an arc of 30° to the right or left of the vertical or horizontal position. When the prism in the slide is exactly at the vertical or horizontal position, the white markers (11–11), one on the circular base of the adjustable bracket, the other on the rigid battery front, marked –0, are in line.

A set screw (12–12) to each bracket holds the prism slide rigidly at any desired angle. When the slide is to be angled away from the vertical position, first loosen this screw.

The prisms are mounted firmly in the slide, insuring positive accuracy of position.

A rod (13) to hold the test chart carrier (14) is mounted

in an upright sleeve from the base plate. This rod may be raised or lowered or it may be removed entirely. A set screw (15) in the sleeve holds the rod at any desired height.

The chart holder is free to slide through the entire length of the rod, which is twenty-one inches long and calibrated in inches and centimeters.

The stereoscope septum (16), for use in the treatment of suspenopsia and weak fusion, can be set at any necessary position. When this septum is in use, it is turned to parallel the batteries, its purpose being to hide the right side of the stereograph from the left eye of the patient and the left side of the stereograph from the patient's right eye (See 16B). When not in use, it is turned to parallel the rod, and is moved up to the end of the rod next to the batteries, where it cannot obstruct the patient's vision (See 16A).

The chin rest (18) can be adjusted vertically by a knurled nut at (19) and horizontally by the set screw (20), thus affording a comfortable rest for the patient.

Raising or lowering of the batteries is accomplished from the operator's end of the instrument by the screw at (21). The locking screw (22) maintains rigidity. This locking screw should be loosened before adjusting the batteries and tightened immediately thereafter.

The pupillary adjustment is operated from either side by knobs (23–23) and the scale (24) is easily read from the operator's position.

There are three rear lens cells (25), accurately calibrated, for the reception of trial case lens corrections for any existing ametropia or presbyopia.

The three front lens cells (26), also calibrated, are for the use of cross-cylinder lenses in the accommodative-convergence balance tests, and for the addition of weak trial plus or minus spheres or cylinders in this test, also for the reception of plus or minus spheres and loose prisms whose use may be desirable while giving exercises. If the patient's

prescription includes vertical prisms for constant wear, their trial case equivalents may be placed in these front lens cells during exercises of the horizontal functions.

These front cells can be changed at will to receive either size of trial case lenses now in use. The operator will see two sets of screw-holes in the cell body. If he uses the 1½-inch trial case lenses, the screws that support the lenses are to be inserted in the outer screw-holes. Or if he uses the 1¼-inch lenses, the screws should be set in the inner screw-holes.

The rear cells are not adjustable, but are made of the size specified when the instrument is ordered. Should the refractionist wish to change his trial set to lenses of another size, proper rear cells can be purchased, and the exchange from one to the other is easily made by anyone.

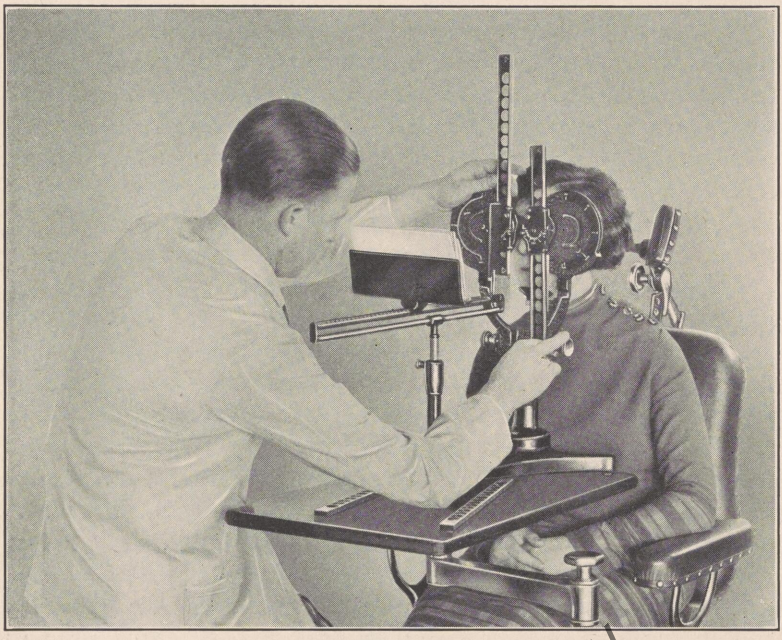
If the operator uses trial lenses with 15 mm. opening, these serve well in the front cells in making the phoria and cross-cylinder tests, but will not be so good for use in the front cells in giving exercises, on account of the restricted lateral fields. The small aperture is no handicap in the rear cells.

The breath shields (27–27) are removable for sterilization.

The chart holder is made to keep all the cards used in near point tests and exercises together, preserving them from loss and soiling, maintaining them in correct position and always ready for immediate use.

Cards are provided in sufficient variety for the tests that are to be made and the exercises that are to be given. But if the refractionist wishes to add others to this collection, they can be easily inserted in the chart holder.

The Genothalmic Kratometer was designed and built to insure the heretofore unobtainable rigidity so essential in giving innervational prism exercises.



KRATOMETER IN USE

OPERATING THE GENOTHALMIC KRATOMETER

THE operator should study the Kratometer adjustments, acquaint himself with their possibilities and develop a method of using the instrument with the minimum of physical effort and the maximum of comfort.

The movement of the prism slides must be rapid and positive. The jump from one prism to the next must be made as quickly as possible. There may be no lagging in the slide movement. So the operator must find that position of body and arms that will enable him to push or pull the slide through the bracket in a quick, positive jump.

The same is true of the rotation of the rotary disks. In these the prism power is increased by turning the top of the

disk outward, away from the nose. For this, we recommend that the hands rest on the outer battery edges, slightly above the center. The battery is grasped between thumb and middle finger, the forefinger extended along the knurled edge of the rotary disk. A quick drawing in of the forefinger turns the disk to the next higher prism power. In turning the disk in the opposite direction to reduce the prism power, the same position of the hand is taken, but with the forefinger bent, the cushion of the last joint pressed against the disk edge, and a quick shove of the finger pushes the disk over to the next lower prism.

While every individual will find a position most suitable for himself, we recommend that the operator seat himself at one side and well to the front of the instrument. Use a high Genothalmic stool to bring the arms in comfortable position, so there shall follow no fatigue in operating the prism slides.

The right handed individual will find his best position at the left side of the instrument. The left hand rests on the top of the right battery (over the patient's right eye.) The slide is grasped by the thumb and finger and pulled upward or pushed downward. The third finger of the right hand rests on the left knob of the pupillary adjustment screw, the slide is held by the thumb and fore and middle fingers and pushed upward or pulled downward. These positions afford a leverage that will make quick movements of the slides possible.

In both rotary disk and slide movements, a click of the self-adjusting pawls notifies the operator when the prism is in true position. In a new instrument the pawl engagement is purposely made strong and stiff. After a few weeks' use, this stiffness will disappear.

With the prism slides at base out and set at zero, the right slide extends upward from its bracket and the left slide extends downward from its bracket. We recommend that these slides be always used in this position, excepting in

the distance phoria test. When prism base in is desired, turn in 5△ or 10△ base in from the rotary disks, neutralize this with 5△ or 10△ base out of the slides, then reduce the slide power step by step. At any time, with this arrangement the effective base in power before the sight aperture is the difference between the powers of the rotary disks and the prism slides. This custom will prove a great saving in time, as it does away with the necessity of withdrawing and resetting the prism slides.

THE POSITION OF THE PATIENT

The patient must be seated comfortably, avoiding any cramped or tiresome position. In particular, there must be no artificial posture of the head which might tend to cramp the neck and bring pressure of the cervical bones on the cervical section of the spinal cord, for such pressure will interrupt the flow of neural energy to the intrinsic muscles of the eyes.

As so much time is wasted in adjusting the ordinary table to this necessary comfortable position, we strongly advise the use of our Kratometer Adjustable Attachment with the Genothalmic Refractionist Chair.

This is swung into position at the correct height and angle immediately, with no time lost in adjusting screws. When necessary, supplemental adjustments of the Kratometer batteries is but the matter of a moment. In general, it will be found convenient to keep the batteries raised to their full height if the instrument is used with this adjusting bracket. Only with very stout persons will there then be any need of individual adjustments. The use of the Genothalmic Chair and Kratometer Adjustable Attachment will be found an economy when the element of time saving is considered.

The patient's head must be well up, eyes in the primary position. He must not be permitted to tilt the forehead forward, for then the eyes will be turned slightly upward,

which is contrary to their natural convergence movement. Both distance and near targets should set somewhat below the level of the patient's eyes, so that his eyes will turn downward a little in the normal visual and convergence position.

THE DYNAMIC DISTANCE PHORIA TEST

THIS is the first step in the refractive examination. It should be made without correcting lenses if patient has not heretofore worn distance glasses, or with the old correction if he has worn glasses for some time. In the latter event, place trial case lenses equivalent to this old correction in the rear lens cells of the Kratometer.

Lower the reading test rod as much as possible. Otherwise, the upper edge of the chart holder will attract some attention, may incite the accommodation appreciably, and the phoria test will be rendered inaccurate.

Adjust the pupillary distance of the batteries to conform to the patient's as used in distant vision if no glasses have been used or to the pupillary distance of the old glasses if any have been used.

Set the axis latch of right battery at *base up* and the axis latch of left battery at *base down*. The disk readings are left at OPEN.

Adjust the instrument in comfortable position before the patient and direct his attention to Chart No. 1, to be used at 6 meters, or greater distance if possible.

Chart No. 1 is printed with both "direct reading" and "reversed" characters so that the tests may be made either without or with a mirror. The table of scale readings given on page 21 enables the refractionist to employ the chart at any distance.

Rotate the left rotary disk to 3△, which will fall into position base down. Ask patient if he now sees two crosses, one above the other. If not, turn in the 3△ of the right

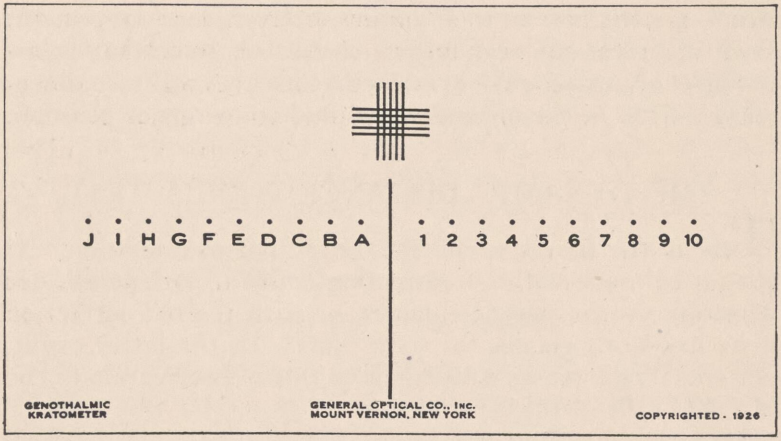


Chart Nos. 1 and 2

rotary disk, which will come in base up. If he still does not see two images, turn the left disk to 5△. If this does not create vertical diplopia, turn in the 5△ of the right disk. If he still does not see double, it is a case of suspenopsia, which will be covered in a later section.

If the vision is so poor that the cross cannot be seen at six meters or more, bring it nearer to the patient, near enough so he can just about distinguish that there is a cross, not necessarily the individual lines composing the cross. It is then within the range of his accommodation, and the test will be dynamic. If one eye be amblyopic it must be favored in this way.

In cases of extremely poor vision, resort may be made to a light and the Maddox Rod, or a light with white glass over one eye and red glass over the other. Such tests are not dynamic and do not give accurate accommodative phoria amounts, but they serve as guides in cases of very poor vision.

When vertical diplopia has been established, the upper image belongs to the left eye, the lower image to the right

eye. Ask the patient if the upper image is directly over the lower image or to one side. If to one side, which side?

If the two images are in exact vertical alignment, it proves accommodative orthophoria. If the upper image is to the left of the lower image, it is a case of esophoria. If the upper image is to the right of the lower image, we have accommodative exophoria.

Next estimate the scale amount of the heterophoria. The periods on the scale of Chart No. 1 are so spaced that at different distances the spacings are equivalent to the following prismatic displacements:

At 1 meter	—3.00△	At 5 meters	—0.60△
" 2 meters	—1.50△	" **6** "	—**0.50**△
" 3 "	—1.00△	" 8 "	—0.37△
" 4 "	—0.75△	" 10 "	—0.30△

At 12 meters —0.25△

In esophoria, the long line or "stem" of the upper target will seem to extend down into the lower row of letters, it will pass through or near a letter. Ask the patient what letter of the lower row this upper stem is near. If it is at A, and the test is at 6 meters, there is a scale reading of 0.50△ of esophoria; if the line seems to run through B, there is 1△ of esophoria; if it is between A and B, there is about 0.75 esophoria, etc.

In accommodative exophoria, the long line or "stem" of the upper target will seem to extend down and pass through or near one of the numerals of the lower row. If it seems to pass through 1, there is 0.50△ of accommodative exophoria at 6 meters; if the stem runs through 3, there is 1.50△ of accommodative exophoria; if it passes between 3 and 4, there is 1.75△ accommodative exophoria, etc.

The next step is to measure the promptness or sluggishness of response to prismatic assistance.

In a case of esophoria, insert one of the 1 △ prism slides into the left bracket with the prisms at *base out.* Push the slide down one notch, thus placing 1 △ base out over the left eye. Ask the patient if the upper cross moved to the right, and, if so, how much? If there is 1 △ or less of esophoria, and the upper cross moves over, under the assistance of the 1 △, so that it goes to the right of the lower target, innervational response is good. Or, with 2 △ of esophoria, if the two crosses are put into vertical alignment with the assistance of only 1 △ base out, functional response is satisfactory. But if the amount of esophoria by the scale reading, and the amount of prism base out required to align the two objects, are equal, we may seriously question the responsiveness of the innervational centers. And if more prism is required for vertical alignment than the amount of the esophoria indicated by the scale reading, we can surely know that innervational response is sluggish, and that Kratometer exercises are in order.

If the case is one of exophoria, insert one of the 1 △ prism bars into the right bracket with the prism base in. Proceed as in the preceding paragraph. Slide the bar down one step at a time, pausing at each change for the eyes to adjust themselves, and asking how much the upper cross has moved to the left. If less prism power is needed for vertical alignment than the amount of exophoria indicated by the scale reading, functional responsiveness to stimuli is excellent. If the prism power equals the scale reading, responsive ability is fair. If more prism than the scale reading is necessary for vertical alignment, nervous response is slow and the need for Kratometer exercises is indicated.

After the refraction is completed, and the distance corrections ascertained, repeat these tests, taking care that the pupillary distance of the batteries conforms to the patient's as used in distant vision. With the new correction on, if there was accommodative orthophoria at the first test, there

should be the same at the second test with the new lenses.

If the new correction is plus, and an artificial exophoria has been created by this, either the plus must be reduced, or prisms base in prescribed, or Kratometer exercises given.

If the reserve adduction tests (method described below) show a strong convergence sense, prisms base in may be prescribed. If the convergence is weak, the plus must be reduced and the convergence reserve built up with Kratometer exercises with prisms base out.

If a previous accommodative exophoria is increased by the new plus correction, the same routine is to be followed as in the immediately preceding paragraph.

Accommodative esophoria, if some still persists with the correction in place, should show a diminution in scale reading and a better response to the trial by prisms base out as described in paragraphs above.

We occasionally meet in the first phoria test an exophoria that disappears or is lessened in amount after the correcting plus lenses are placed before the eyes. This is an exhaustion exophoria, and seldom needs further treatment than the exact correction of the refractive error.

DYNAMIC PHORIA TEST AT THE READING POINT

The procedure is the same as in the dynamic phoria test at distance. Use Chart No. 2 (illustrated on page 19). The spacings of the periods on this card at various distances are equivalent to prismatic power as follows:

At 100 cm.	—0.70△	At 30 cm.	—2.33△
" 70 "	—1.00△	" 28 "	—2.50△
" 50 "	—1.40△	" 25 "	—2.80△
" 40 "	—1.75△	" 23 "	—3.00△
" **35** "	**—2.00△**	" 20 "	—3.50△
" 33 "	—2.12△		

The pupillary adjustment of the batteries should be made about 4 mm. less than the patient's distance interpupillary distance.

The usual reading distance is about 35 cm. But ascertain the individual's accustomed reading distance, and make the dynamic phoria test at that point.

Usually, there is a little more accommodative exophoria at the reading point than at the far distance. The difference in amount between the distance phoria and the reading point phoria is, when not due to exhaustion, the physiological exophoria, and indicates incomplete development of functional relaxation of the external recti. If it amounts to more than 3△ or 4△, this excessive exophoria is often due to exhaustion from the lack of sufficient plus correction; we may, however, suspect hysteria or toxemias.

If the patient has been wearing reading glasses, make the dynamic phoria test with that correction in the rear lens cells of the Kratometer. If he has not been wearing a reading correction, but has been using distance glasses, make the test with this former distance correction in the Kratometer.

Interpretation of these tests is the same as in the distance tests. Compare the scale readings with the amount of prism needed to align vertically the two targets. Often response is good at distance but poor at near. The amount of accommodative exophoria is of less moment than the innervational response to the assistive stimulus of prisms base in.

In exophoria from exhaustion, the response to prismatic assistance will at once show improvement when the correct reading lenses are put in front of the eyes. And usually the amount of exophoria is decreased at once by these correcting lenses. But of the physiological exophoria, there should be no change in either amount or in response by the correction of the presbyopia or the refractive error.

In presbyopia, if the addition of sufficient plus lens strength to enable the patient to read fine type should in-

crease the exophoria, it may be inferred that not sufficient plus has been included in the distance correction, there is latent hyperopia and latent exophoria. Relax the convergence and break down the association of convergence and accommodation at the distance by Kratometer exercises and the temporary prescription of prisms base in. See the sections on "Exercises for Convergence Relaxation" (page 51); and the "Cross Cylinder Tests" (page 76).

If the amplitudes of accommodation and convergence are both sub-normal, innervational exercises with the Kratometer, the target set at the reading distance, should be instituted. See the section on "Exercises for Developing Amplitudes and Association of Convergence and Accommodation" (page 59).

For test for convergence insufficiency, use Chart No. 3 as described under "Suspenopsia Tests" (page 37).

PHORIA TESTS WITH THE MADDOX ROD

HORIZONTAL TEST

Use a small spot light at the distance. The smaller the better. Darken the room. Let there be no source of light that may cause an extra streak in the Maddox Rod, for this will produce confusion and uncertainty. Adjust the instrument in position and turn in the Maddox Rod over the eye with the better vision, leaving the poor eye fixing the light. Adjust the axis latch at either base up or base down. The streak will now appear vertical.

If the Rod is over the left eye, and the streak appears to the patient to be at the right of the light, exophoria is indicated. With the horizontal slide at base in, find the amount of prism that will bring the streak through the center of the light.

With the Rod over the left eye, if the streak appears to the left of the light, esophoria is indicated. With the horizontal

slide at base out, find the amount of prism that will set the streak into the center of the light.

With the Rod over the right eye, exophoria is indicated when the streak is to the left of the light; and in esophoria, the streak is to the right.

Orthophoria is manifest when the streak cuts the center of the light without prismatic aid.

Many persons will have difficulty in seeing both light and streak at the same time. Others will see them both, then one or the other may disappear. This is evidence of suspenopsia.

As an uncertain and unknown amount of accommodation is in force when the Maddox tests are used, these will not be dynamic tests, nor will the accommodative phorias be correctly indicated. With the accommodation suspended with atropine, the Maddox Rod will indicate the static phoria with a fair degree of exactness. For this reason, we recommend that the dynamic phoria test described previously be used when atropine is not employed.

VERTICAL TEST

Turn the axis latch to either base out or base in. The streak is now horizontal. In vertical balance, the streak will cut the center of the light.

With Rod over the left eye, if the streak is below the light, the left eye is turning up, or the right eye is turning down. With the vertical prism slide, find how much prism base down over the left eye, or base up over the right eye, will bring the streak to the center of the light.

With Rod over the left eye, if the streak is above the light, the left eye is turning down, or the right eye is turning up. With the vertical prism slide, find how much prism base up over the left eye, or base down over the right eye, will bring the streak to the center of the light.

With Rod over the right eye, if the streak is below the light, the right eye is turning up or the left eye is turning

down; if the streak is above the light, the right eye is turning down or the left eye is turning up.

Such findings of evident hyperphoria must not be accepted as proof of true hyperphoria. These findings are merely evidence of lack of innervational control, and are as often due to convergence troubles and to accommodative-convergence imbalances as to faults in the vertical muscles.

THE ABDUCTION TESTS

ABDUCTION should be considered as the ability of the convergence to relax. The amount of abduction at distance is of importance in esophoria, as indicative of the ease and speed of the readjustments which must always follow every accommodative effort in distance vision; and should be taken in that type of myopia due to excessive and associated convergence-accommodative efforts, and will indicate how much prism base in can be successfully worn in the attempt to relax accommodation and reduce the amount of myopia.

Place the distance correction in the rear cells. Adjust the pupillary distance of the instrument to the same as the patient's for distance vision.

Set both rotary disks at 5△ base *in*. Insert the prism slides with prism base *out*, adjusting them at 5△. You now have 0△ before the sight apertures. Make the test at 6 meters or more, using Chart No. 1.

Pull the right slide up and the left slide down. Operate both prism slides simultaneously, giving equal prismatic power to the two eyes. Allow a second or two between each change of prism power.

If zero of the prism slides is reached (giving effective power of 10△ base *in* from the disks), without causing diplopia, move both slides to 10△ base *out* and turn in 10△ base *in* from both rotary disks. You again have 0△ before the sight aperture. Once more reduce the prism power of the slides, until diplopia results. The power of the

abduction is the *difference* between the *base in* of the disks and the *base out* of the slides.

The esophore should have a convergence relaxation of four or five times the amount of the manifest esophoria to avoid headaches. If there is an esophoria of 3△, there should be present a possible relaxation of at least 12△. If this proportion is shown in the abduction test, there will be little discomfort due to the esophoria.

In that type of myopia due to close association of convergence and accommodation, one-third of the amount of the abduction can be safely prescribed for constant wear, if such prisms base in actually relax the accommodation enough to permit the prescription of weaker minus lenses with equally clear or better distance vision as stronger minus lenses without prisms afford.

Some esophores have the unfortunate habit of suppressing one image the moment a slight diplopia occurs, rather than to make the necessary effort of convergence relaxation. The operator must watch this habit, for if one image is suppressed, prism base in can be added indefinitely without diplopia occurring. If one image is suppressed, the target will seem to move in the direction of the prismatic displacement of the image as it appears to the non-suppressed eye.

If the right eye's image is suppressed, the target will appear to travel to the left. If the left eye's image is suppressed, the target will apparently move to the right. Therefore, the operator should warn the patient to speak the instant the target seems to move to right or left. The target should appear to remain in the center, and will become blurred as the prism base in increases in power. The addition of more plus sphere usually clears the image somewhat, especially if the accommodation relaxes as we wish it to.

Suspenopsia in myopia causes the same effect of the target's seeming to move to one side, and will have to be guarded against.

If the target does seem to move over to one side, hold the hand in front of the seeing eye, when the suppressed or suspended eye will resume vision. On uncovering both eyes, usually two images will be seen. Reduce prism power until one image is seen in the center.

The habits of suppression and suspension are sometimes very pronounced, and will then reveal themselves in the suspenopsia tests. Again, the suspension occurs very rarely and persists for only a fraction of a second. It is this latter type that the operator must guard against in all duction tests and exercises.

Warning that but one eye is actively concerned in the test is given when the test object seems to move to one side, or when the image does not become blurred when the prisms are increased above the amounts normally to be expected in the various ductions. Therefore, the patient must be carefully instructed to speak when the object seems to move and when it begins to blur.

ADDUCTION TEST

As a rule, adduction need only be taken at the reading distance. Occasionally, however, a study of the adduction reserve and innervational response at distance will materially assist in the case analysis.

Adduction need not be taken in esophoria, for in this imbalance only the abduction is of importance.

Adduction should never be taken in myopia, for the accommodative "spasm" might be increased by this added incitation to convergence and convergence-accommodative effort.

Adduction should be considered as the ability of the external recti to relax and permit convergence. The test must always be taken in accommodative orthophoria and accommodative exophoria with hyperopia. A finding of accommodative orthophoria is no proof of convergence sufficiency, nor

is the presence of accommodative exophoria evidence of convergence insufficiency.

Set the pupillary adjustment scale at 4 to 6 mm. less than the patient's distance interpupillary measurement. Set the rotary disks at OPEN and the axis latches at base *out*. Insert both prism slides in the brackets, with the prisms base *out*, adjusting them at *zero*. Use Chart No. 2 or No. 11, setting the card holder at the patient's usual reading distance, 35 to 40 cm. from the eyes. This distance is indicated on the rod scale.

Operate both slides at the same time. Take the adduction four or five times in quick succession without permitting an interval of rest.

As the first test, use the horizontal prism slides, commencing at zero and increasing the prism power by increments of 1 △ over each eye. Advance the two slides simultaneously, pausing for about a second between each jump, continuing until the patient sees two targets. The true reserve is measured by the ability to maintain one clear image. Blurring commences a few points before the actual break into two clear images.

When the adduction power is greater than the 26 △ of the two slides, return the slides to zero, turn in as much from the rotary disks as can be overcome (equal power to the two eyes), then add 1 △ steps from the slides. The sum of the prisms used from disks and slides is the measure of the reserve adduction.

On reaching the point of diplopia, do not permit the patient to withdraw from the instrument, but immediately commence the reduction of prism power, one step at a time, and alternating between the two eyes. Note at what prism strength he is able once more to pick up the single image. If he can overcome considerable prism power before diplopia occurs, and can recover the single image after a slight reduction of the prisms, innervational response and quickness of

adjustment are good. But if the prisms must be reduced almost to zero before he can re-fuse the images, the habit of response is uncertain and sluggish.

After the first adduction test, do not permit the patient to rest, but return at once to zero and repeat the test. Note again the total power obtained and the point at which he recovers single vision. If the finding in the second test is less than in the first test, it shows susceptibility to fatigue, and without doubt Kratometer exercises will be beneficial.

If the second test proves as good or better than the first, that is an encouraging sign. But return to zero once more and make a third test, thus getting a better knowledge of his ability to withstand fatiguing work. If the third test is as good as the first two, we can feel greatly encouraged as to his ability to do a day's close work without fatigue.

Make the fourth test at a rapid rate. Allow only the briefest pause between prism jumps. This is a speed test, and must be made fast. An individual with good innervational resources and quick adjusting habits will take care of nearly as much prism power under the speed test as under the previous tests in which ample time was allowed for recovery. But the one with poor resources will fail badly under this test, especially as it is to be made under somewhat fatigued conditions. If the first "speed" test makes a good showing, repeat two or three times in quick succession, to see if patient can continue work without fatigue. If the first duction tests bring on fatigue, do not make any more, cease at once, for you have discovered what you wish to know.

There is no set amount of reserve adduction that will indicate whether or not an individual has the required innervational resources. While the ideal is around 40△ to 50△, there are many with much less reserve than this who are perfectly comfortable. And there are others who will show ability to overcome considerable amount of prism base out, who are very uncomfortable when they are compelled to

maintain vision at one point for a considerable length of time.

The findings of the phoria and duction tests are to be studied in detail and in comparison. If the phoria test shows some exophoria, but less prism is required for alignment of the two images than the amount indicated by the scale reading, and if the adduction test shows a fair amount of adductive power with quick recovery to single vision as the prisms are decreased after diplopia occurs, and if in each succeeding duction test as good a showing is made as in the preceding ones, and if the speed duction tests make a good showing, we need not worry if the *amount* of the adduction reserve is not high. But, if the exophoria is increased by the addition of the plus lenses that correct the monocular refractive errors, if there is not quick recovery from diplopia in the adduction tests made as above described, or if there is fatigue shown in repeated adduction tests, then innervational exercises ought to be given, regardless of the amount of "pulling power" shown in the first adduction test. It is the *quality* of responsiveness that is essential, irrespective of the *quantity* of prism power overcome.

As in the abduction test, warn the patient to speak at once if the image seems to move away from the center, and to advise you when the image begins to blur. Blurring commences, as a rule, within two or three steps of actual diplopia.

With individuals possessing a high convergence amplitude, it is possible to so much increase the base out prism power that the object is displaced to such a degree that it becomes invisible to one or the other of the eyes. Then the operator continues to advance prism power under the impression that he is measuring adduction, when, in fact, only one eye is following the image, while the other eye is looking at a blank piece of paper in the near test, or at the wall of the room in the distance test. This occurrence is more apt to happen if much more prism is used over one of the eyes than over the

other. Therefore, we advise the equal division of prismatic power between the two eyes.

Some persons will realize that "there is something wrong." They will state that they seem to be using one eye only. Others will not notice the disappearance of the test object from one eye while the prisms are being increased, but when the prisms are reduced they will see a second image coming in from one side.

There are two possible causes explanatory of this difficulty. The sight openings may be too widely separated. Or the patient may not be well positioned, he may be a little to one side, or he may not be squarely facing the instrument. Or one eye may be farther from the nose than the other, in which event the instrument should, of course, be so adjusted that the eyes center in the sight openings.

As a check against this occurrence, occlude the left eye and turn in 20△ base out over the right, asking if the test object is in full view of the right eye with this prism in place. If not, readjust the instrument. Then occlude the right eye, turn in 20△ base out over the left, and make sure that the test object is in full view to this eye. Check both eyes once more, and when the adjustment is satisfactory, turn the 20△ prisms out of the sight openings, and proceed with test or exercises.

This difficulty seldom arises, but we give this attention to it so that when it does occur the operator will know the cause and the remedy.

Nearly all persons with convergence difficulty are more or less inclined toward occasional lapses of vision in one eye or the other. This defect of functioning is called suspenopsia.

If one eye suspends while testing or exercising with prisms base out, the image will appear to move to the side of the suspending eye. If the right eye suspends, the prismatic effect in front of the left eye will make that eye's image move to the right. If the left eye suspends, the right eye's image

seems to move to the left. This is just opposite to the effect when suspension or suppression occurs when working with prisms base in.

Instruct the patient to advise you if the object seems to move to one side or the other. When there is no suspension, the object remains in the center, seems to come nearer and blurs as the base out prism power increases, and seems to recede and grow plainer as this prism power is decreased. If, while the adduction is being taken, the image grows blurred, then suddenly becomes plain, suspenopsia has occurred. It seldom, save in very bad cases, occurs while the prisms are being decreased. Routine for suspenopsia tests and treatments is given in succeeding sections. (Page 37.)

The operator must ever be alert that he may detect possible suspension. For it might be possible to unknowingly credit the patient with a high adduction reserve when he really has very little, one eye or the other having suspended when the least effort of convergence was demanded. Always impress on the patient that he shall speak if the object seems to move to one side. If this occurs, reduce the prism power to zero and start over again, allowing long pauses between prism jumps. If the habit is persistent, turn at once to the Suspenopsia Tests.

Sometimes a patient will see two test objects on first looking through the sight openings, even though there is no displacing prism in place. This is not conclusive evidence of heterophoria nor of functional insufficiencies. It is indicative of slow adjusting habits.

HYPERPHORIA: VERTICAL TESTS

There is comparatively little true hyperphoria, but in imbalances between convergence and accommodation there appear spurious hyperphorias. These latter will disappear when convergence and accommodative efforts are balanced,

either by correcting lenses or Kratometer treatments, or by the two in combination.

Displacement tests for hyperphoria are unreliable because of the innervational or inhibitory effect on the obliques of such tests.

A finding of hyperphoria by any of the classic tests must be confirmed by vertical duction tests. Reliable vertical ductions have been unobtainable by any apparatus until the introduction of the Kratometer, with its 0.25△ units, made them possible.

Suspenopsia is so often present in difficulties of the verticals, that we strongly advise the use of the vertical test described under suspenopsia. But if the operator is positively assured that the patient is entirely free from the suspension habit, the following procedure may be followed:

The test may be made at either distance or near. Correcting lenses should be in the rear lens cells. Adjust the pupillary distance of the batteries to conform to the patient's for the distance at which test is to be made. Set the rotary disks at OPEN.

Insert one vertical prism slide at *base up over the right eye*, the other vertical prism slide at *base down over the left eye*, with the open cells in the sight openings. Use Chart No. 1 for the distance test, Chart No. 2 for the near test.

Advance the prism power one step at a time, alternating the steps between the eyes, first over the right then over the left. Allow a second or two between each prism jump. You are now testing the right inferior rectus against the left superior rectus. The duction ability is measured by the combined prism power over the two eyes at the last step before diplopia occurs.

Then reverse the vertical prism slides, setting one at *base down over the right eye* and the other at *base up over the left eye*. This will measure the right superior rectus against

the left inferior rectus. Proceed as before, and compare this finding with that of the first test.

Only these two tests are necessary. First, the measurement of the antagonistic abilities of the right inferior rectus against the left superior rectus; second the antagonism of the right superior rectus against the left inferior rectus. This is the power of possible dissociation of the primary impulse to turn both eyes up or both eyes down.

When the upward ductions of the right superior and left superior recti, or the relaxing ability of the right inferior and left inferior recti, are unequal there is a tendency to hyperphoria. Or when the downward ductions of the right inferior and left inferior recti, or the relaxing ability of the right superior and the left superior recti, are unequal, there is tendency to hyperphoria. These comparative ductions and relaxations are found by putting in antagonism the right superior rectus and the left inferior rectus, and pitting the left superior rectus against the right inferior rectus.

If the findings by these two tests are equal, there is no vertical imbalance. If, however, the possible ductions are low, say only 2.00△ or 2.50△ is the sum of the powers in both vertical prism slides in both tests, then possible motility and freedom of action is low, and vertical exercises should be given to increase the range of elastic movement.

If there is more than 0.50△ or 0.75△ difference between the two findings, exercises should be given to increase the range in the direction of the lower duction. For example, if the right inferior against the left superior shows ability to overcome 4.00△ while the power of the right superior against the left inferior is only 3.00△, exercises should be given to build up this lower power to an equality with the first.

It is very rarely possible, if there be a structural defect of any of these vertical muscles, to locate the exact muscle, and such location is not necessary. It is only essential to know the

functional ability and the innervational resources at command for overcoming the structural error.

In the event that a vertical diplopia is manifest at once, if the patient at first glance sees two test objects, the proper procedure is detailed in the instructions for the use of Chart No. 4, in the section on "Vertical Ductions in Suspenopsia."

The treatment of hyperphoria is detailed in the section on "Exercises for Hyperphoria" (page 65).

HORIZONTAL PHORIA TEST IN CASES OF SUSPENOPSIA AND SUPPRESSION

Use Chart No. 3, set at 35 cm. from the eyes. Put reading correction in rear lens cells. Adjust the pupillary distance of the batteries in exact agreement with the patient's reading pupillary distance. Draw forward the stereo septum, turn-

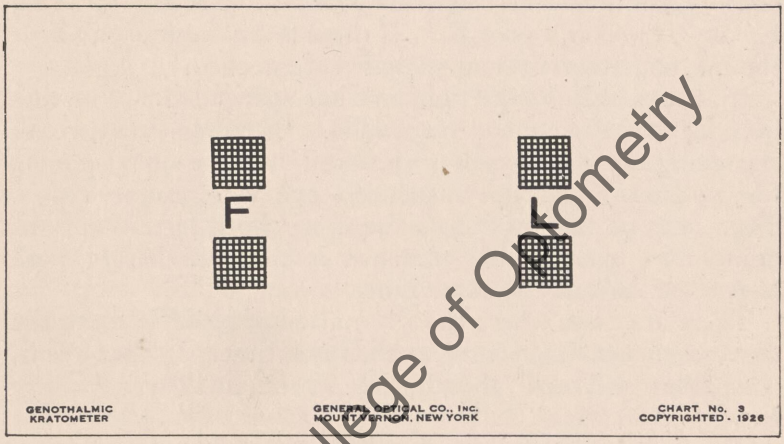


Chart No. 3

ing flat side toward the patient. The correct position for this is from 15 to 20 cm. from the patient's eyes. The wider the P.D., the further out is set the Septum.

On Chart No. 3 are the letters F and L. The Septum is to be adjusted so that the F is seen only by the left eye and the L is only visible to the right eye. Fused, the F and L combine to make the letter E.

The checkered squares on this card are often useful in checking the astigmatic corrections. See the section on torsions and oblique astigmatism (Page 71).

Set the rotary disks at OPEN. Insert the horizontal prism slides in their brackets with 10△ base *out* before each eye, a total of 20△.

If the patient now sees the letter E, balance and good fusional development are indicated. If he sees L - F, it shows convergence insufficiency. If he sees F - L, convergence is over-innervated. To fail to make E with 10△ base out over each eye, indicates poor fusional sense and lack of nervous control. Some persons will fuse a fine, clear E at once. Others will hesitate, finally say, "It seems to be an E," or "It makes a poor E." If there is any hesitation about the matter, innervational exercises are needed.

If he sees only F, the right eye has suspended. If he sees only L, the left eye has suspended. In either event, cover the seeing eye (hold a card or the hand over the sight opening for a second) and the suspended eye will resume vision. Then remove the cover and inquire if both letters appear. Sometimes considerable patience is required before both letters are seen at the same time.

There are cases where the alternation of vision is total, the two eyes never functioning at the same time. In that event, the patient will see F, then L, then F, etc., but never F - L or E.

The defect of complete alternation cannot be eradicated, but the habit of occasional suspenopsia can be completely cured with Kratometer exercises.

If the patient does not at first see E, but sees F - L, increase the prism strength until he sees E. If he sees L - F,

decrease the prism power until the E is obtained. At every step make sure that neither letter disappears.

The amount of over-innervation of the convergence is measured by the amount of additional prism (above the normal 20△) required to fuse the two letters into E.

For example, if 12△ is required over each eye for fusion, a total of 24△, the convergence over-innervation is 24△ − 20△ = 4△.

If more than 13△ to each eye is required, turn in additional 3△ base out from the rotary disks.

The amount of convergence insufficiency is measured by the amount of reduction necessary from the normal 20△. If the slides must be reduced to 6△ over each eye, the convergence insufficiency is 20△ − 12△ = 8△.

Always commence this test with 10△ base *out* in prism slides before each eye, which is the normal prism power with the card at 35 cm. To start with any other strength will lead to misleading conclusions.

Among the tests for convergence insufficiency the "F - L" Chart used with the Genothalmic Kratometer is the most sure and definite. Even if there is no suspenopsia, this test should be made as a routine part of every examination.

Ordinary phoria and duction tests tell nothing of the functional sufficiency or insufficiency of convergence. But the truth is immediately revealed by the patient's success or failure in forming the letter E with the normal 20△ base out in the Kratometer.

True convergence insufficiency is due to incomplete development of the function. Kratometer exercises, with base *out* prisms, will quickly educate this function and bring relief to the sufferer.

Do not confuse this with the insufficiency of exhaustion often found accompanying esophoria and latent hyperopia, and due to the terrible drain on the nervous system in furnishing compensating accommodation to overcome the hyperopic

error. In this type, give relaxation exercises, with base *in* prisms, and uncover and correct the latent error by the cross-cylinder methods described in another section.

After finding the prism power that will fuse the F and L into E, take the adduction and abduction reserves.

Abduction is taken by decreasing the prism power. When the E breaks into F - L, and cannot be re-fused, the limit of abduction, or convergence relaxation, has been passed.

It is possible for a good relaxation ability to hold the E down to the Zero openings, and even to overcome as much as 3△ or 5△ base in from each rotary disk.

Adduction reserve is taken by increasing the prism base out. When the E breaks into L - F, the adduction reserve power has been passed.

It is a very poor showing when at least 5△ base out from both rotary disks in addition to the full power of the prism slides is not readily overcome.

If the start is at 10△ base out over each eye, and the break into L - F occurs after passing 23△ base out over each eye (10△ from each rotary disk and 13△ from each prism slide) which is a total of 46△, the adduction reserve for the reading distance is 46△ − 20△ = 26△. If this same person is able to relax the convergence down to the zero openings and up to 6△ base in (3△ base in over each eye) before the E breaks into F - L, the convergence relaxation at the reading distance is 20△ +6△ = 26△.

If the initial fusion point is at 16△ base out (8△ over each eye) and the adduction is carried to 24△ (12△ base out over each eye) before the break occurs, the reserve adduction at the reading distance is 24△ − 16△ = 8△. With this same starting point of 16△, if the abduction is carried to 2△ base out (1△ to each eye) the convergence relaxation at the reading distance is 16△ − 2△ = 14△.

Always, the adduction reserve is the difference between the amount of base out which originally fuses the E and the amount that can be held before the E breaks into L - F. And the convergence relaxation is the difference between the initial fusing amount and the power that is held just before the E breaks into F - L.

As stated previously (see Adduction Test), speed and ease of adjustment are more essential than the amount of prism overcome. In the suspenopsia cases, to the three items of amount, speed and freedom from fatigue must be added the ability to maintain unintercepted binocular vision.

Warn the patient, when making the phoria or duction tests with this card, to speak instantly if either letter disappears, and do not proceed with further prism changes until the E is seen. Very often, in taking the ductions, and in giving exercises, when one of the eyes suspends, it is necessary to take several backward steps with the prism slides before the E can be re-fused.

In the very rare cases of total intermittency, where both eyes never see at the same time, no ductions can be made, for there is no knowledge of fusion.

In pronounced cases of suspenopsia, let the patient name, after each change of 1 △ prism, the letter or letters he sees. This not only advises the operator as to the degree of intermittency and warns against further prism change until both eyes see and fuse, but teaches the patient the necessity for constant attention. It is lack of attention in the secondary visual centers (in the cortex of the brain) that is the cause of intermittency of vision, or suspenopsia. Kratometer treatments attract the unremitted attention of secondary visual centers of both eyes, and create the desired habit of continual attention.

If either letter should appear higher than the other, prisms from the trial case may be inserted in the front lens cells to bring the two letters to the same height. This is very liable

to occur in toxic diseases that have affected nervous conduction, and must not be taken as evidence of true hyperphoria.

In esophoria, occasional cases of suppression of vision in one or the other eye will be met. In treating these, the same methods are to be used as in treating suspenopsia.

Regular exercises with a single test object cannot be instituted until the habit of suspenopsia has been completely eradicated.

Suspenopsia frequently accompanies myopia. In troublesome exophoria and convergence insufficiency, suspenopsia is almost always present. About 10% of all the cases that come to the refractionist are afflicted with suspenopsia.

More than half the cases needing innervational exercises are troubled to a greater or less extent by suppression or suspenopsia. The first exercises are to be devoted to the eradication of this habit, and it is useless to proceed in other directions until this has been accomplished.

The Genothalmic Kratometer is the first instrument to be specifically designed for the treatment of suspenopsia.

VERTICAL DUCTION TESTS IN SUSPENOPSIA

Use Chart No. 4, set at 35 cm. Reading correction is placed in rear lens cells. Adjust the instrument as in the F - L test, but in place of using the horizontal prism slides, set both rotary disks at 10△ base *out*. Insert the vertical prism slides in the brackets as already described under Vertical Ductions.

If the F - L were not fused into E by the normal 20△, make up the deficiency by using loose prisms from the trial case, such prisms being placed in the front lens cells. If the patient saw F - L, these compensating prisms are placed base out. If he saw L - F, the compensating prisms are placed base in. If the deficiency is only 1△ or 2△, only one prism need be used, placed over either eye. But if the de-

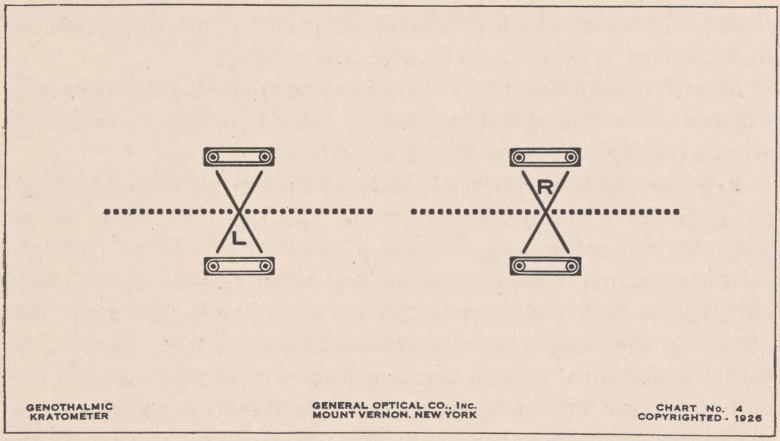


Chart No. 4

ficiency is considerable, it is better to divide the compensation between the two eyes.

The patient should now be able to fuse the two X's and the ornaments and see one line of dots. The letters R and L are tell-tales against suspenopsia of right or left eye.

The procedure is now exactly the same as in taking vertical ductions with a single target, but warn the patient to speak instantly if either the R or L disappears. In this event, cover and uncover the seeing eye rapidly until the suspending eye resumes vision and fusion. In bad cases of suspenopsia, proceed deliberately, pausing for two or three seconds between each prism jump.

In using Chart No. 4 for the vertical ductions, the aim is to find how many quarter diopter steps can be made before the row of dots breaks into two rows. The ornamental oblongs serve as guides, or controls, to the extra-macular version fields. The X's serve as guides to macular fusion, and as indicators of convergence function.

If at the beginning of the test, with no vertical prisms before the sight openings, the patient sees two rows of dots,

insert in the front lens cells loose prism from the trial case of sufficient power to make one row of dots.

If such compensating vertical prism is used, its power is to be added to the duction that is found in the direction in which the apex of this prism is pointed.

For example, suppose 2△ base up is needed over the right eye, its apex is pointing down to the right inferior rectus. Therefore it is already forcing a duction of 2△ to the right inferior rectus. Then, proceeding with the ductions, with this 2△ in place, and with the vertical prism slides at base *up* over the *right* eye and base *down* over the *left* eye, we find we can use 3.50△ more before the antagonism of the right inferior rectus against the left superior is overcome. Therefore, the duction of the right inferior rectus against the left superior rectus is 2△ + 3.50△ = 5.50△.

Then, if we find that the limit of the antagonism of the left inferior rectus against the right superior rectus is 1.50△, the deficiency of these antagonists amounts to 5.50△ − 1.50△ = 4△.

The half of this deficiency, or 2△, is the measurement of the right hypophoria or the left hyperphoria, whichever we denominate the imbalance.

If we practise the old rule of "Prism in the Position of Rest," we should give this 2△ as base up to the right or base down to the left or divided equally between the two eyes. But Kratometer practice is to give such treatment that the ductions are equalized, and the hyperphoria becomes non-existent, as further discussed under the "Treatment of Hyperphoria."

While taking the vertical ductions with Chart No. 4, investigate at the same time the tendency to cyclophoria. When the two rows of dots appear, ask the patient if they are parallel or if one is oblique. In the latter event, cyclophoric tendencies are present. See the section on "Torsions and Cyclophoria" (page 71).

EXERCISES FOR SUSPENOPSIA AND SUPPRESSION

USE at first Charts 5, 6 and 7. When these pictures can be successfully used without loss of either image and the ductions have been built up to a fair amount, add the stereoscopic charts 8, 9 and 10 to the group of daily exercises.

In Chart No. 5, the child is common to both eyes. The gnome at the right with pointing finger is seen by the nasal side of the right retina. The gnome at the left with the broom is seen by the nasal side of the left retina. With the two images of the child fused, gnome with broom is on the left and gnome with pointing finger is at the right.

In Chart No. 6, the tree is common to both eyes. The hornets' nest is seen by the temporal side of the left eye. The boy is seen by the temporal side of the right eye. In the stereoscope, with the trees fused, the boy will be on the left side of the tree and the nest is at the right.

In Chart No. 7, the pirate's face and hat are common to both eyes. The patch on the hat is slightly smaller than the diameter of the macular field at 35 cm. The skull is seen by the right macula, the crossbones is seen by the left macula, if the attention is fixed on skull and crossbones as it should be while exercising with this card.

Suspension may occur in any one of these various fields, without the other fields being affected or losing vision. This set of three cards is designed to offer a series of exercises that will command the constant attention of each of these visual fields in turn, and to give proper attentive education to these fields.

If the patient, at any time, remarks that part of one of the figures is disappearing, a white space moving up in place of the figure, we may justly suspect scotoma. If one of the figures moves out of its proportionate distance to the other figures in the picture, doubtless suspenopsia in one of the fields has occurred. For example, in Chart No. 6, the nest

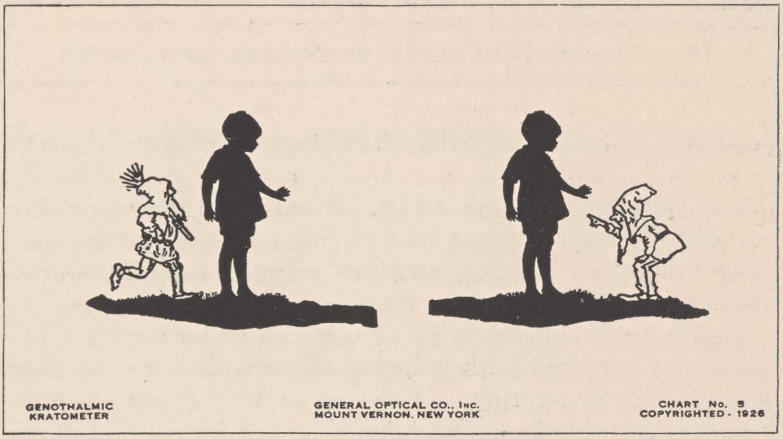


Chart No. 5

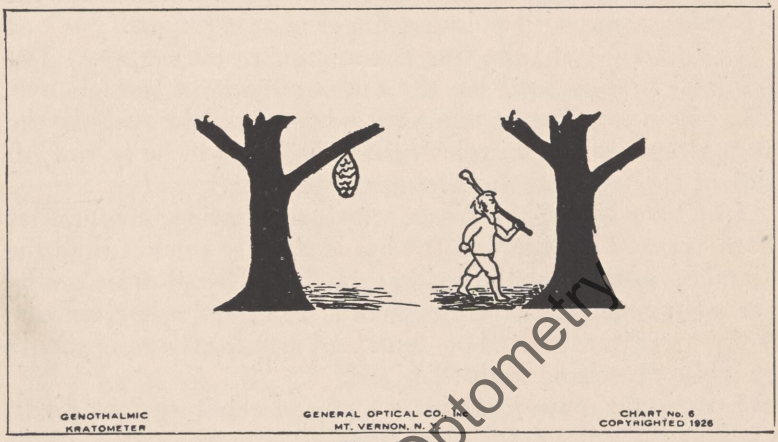


Chart No. 6

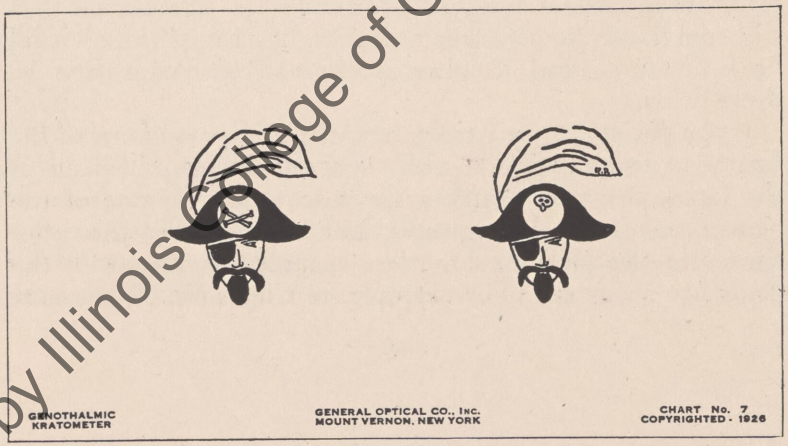


Chart No. 7

might move out to the end of the limb, or in Chart No. 5, one of the gnomes might seem to walk up to the child, even go behind him. Then, surely, the function of fusion is suspended.

Set the card at 35 cm., with the stereo septum drawn forward to its proper position. Make the proper combination of prism base out from rotary disks and horizontal slides to accomplish fusion, as found in the phoria test with the F - L card. Have equal amount of prism over each eye.

If the F - L fused into E with 10△ base out over each eye, adjust the rotary disks to 5△ over each eye and the horizontal slides to 5△ over each eye. This will give the total required, and the slides are in position to be moved in both directions.

If more than 10△ over each eye was needed to fuse the E, use as much power from the prism slides and as little from the rotary disks as possible. If no more than the 13△ of each slide is required, set the rotary disks at zero and the slides at 13△. If more than this is needed for fusion, use 3△ base out from the rotary disks and make up the balance from the horizontal slides. As this is a condition of over-innervation of the convergence, no adduction exercises are to be given. Work entirely on development of convergence relaxation, by reducing, step by step, the power in the horizontal slides.

If less than 10△ over each eye formed the E, set the rotary disks at zero and the horizontal slides at the required power. Exercise the adduction by increasing steps of the horizontal slides. As adduction reserves increase, more power, base out, can be introduced from the rotary disks.

If more or less than the normal 10△ to each eye is required for fusion, let the exercises be devoted to building up that innervational condition that will enable the patient to fuse the two images of any and all of these charts with this normal

10△ base out to each eye when he first looks through the sight openings. After this primary desideratum is attained, and any habit of suspension or suppression is eradicated, the attention can be turned to increasing speed and freedom from fatigue, using Chart No. 11, as described in later sections.

If, at the beginning, the pictures are fused with the normal 10△ base out to each eye, exercise both the adduction and the abduction, until all danger of suspension is surely eliminated. Vertical exercises are also to be given daily, using the same cards, Nos. 5 to 10, inclusive.

STEREOSCOPIC VISION

USE Chart No. 8. Positions of chart, septum, pupillary distance, prism slides, etc., are the same as with the F - L card.

When fused, these two drawings will present a picture of a deep box, if there be the sense of stereopsis. If this sense is absent, the picture will appear merely as a flat drawing. As prisms are slid up and down before the eyes, to the person

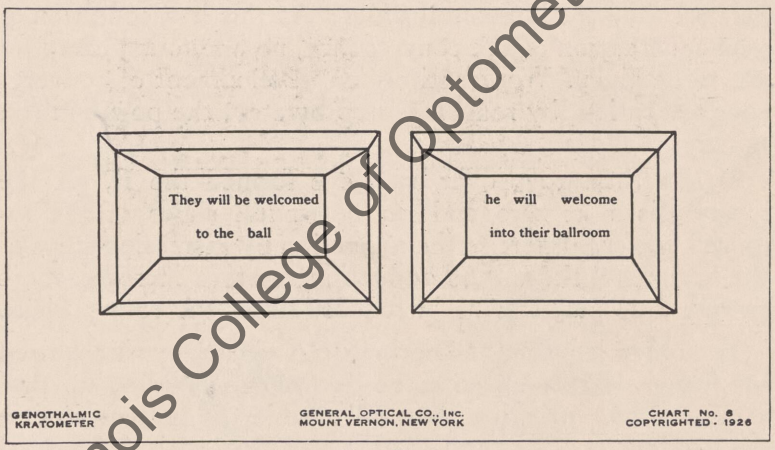


Chart No. 8

with stereoscopic sense the box will apparently grow deep or shallow, depending on the direction in which the prisms move.

The sentences printed on this chart are for the purpose of warning against suspenopsia.

For exercises to develop the stereoscopic sense, use Charts 8, 9 and 10. To these may be added the use of stereo geometric figures, which are for sale by many jobbers, and the usual stereo-photographs which may be had from the various photographic concerns specializing in their production.

Stereoscopic sense enables us to judge of depth, distance and relief. Persons devoid of this sense seldom prove safe motor drivers. Stereopsis develops rapidly under Kratometer treatments, more rapidly than with any methods yet employed.

Exercises in motility should also be given, developing the powers of quick adjustment.

A course of stereoscopic exercising should be made a part of the routine of all exercising, including those for increasing

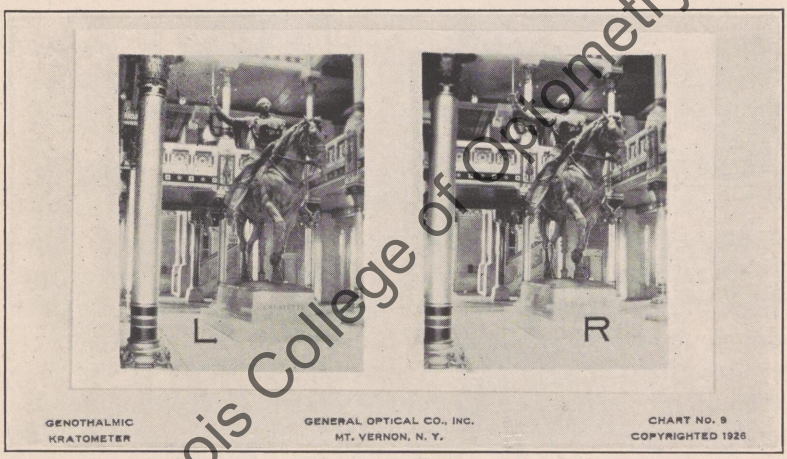


Chart No. 9

reserve adduction, accommodation and convergence amplitudes, convergence relaxation, etc.

On Chart No. 9, the letters R and L are used as warnings against suspension of one eye or the other. Any other stereoscopic pictures used in exercising should be similarly marked.

In Chart No. 10, to the person without stereoscopic sense, the arrows of the windvane will fuse but will seem to lie flat against the card. But to the one blessed with stereopsis, the arrows will stand at angles to each other, and as the prism slides are run up and down before the eyes the arrows will seem to swing back and forth. Note the slight differences in the two pictures as guards against suspension.

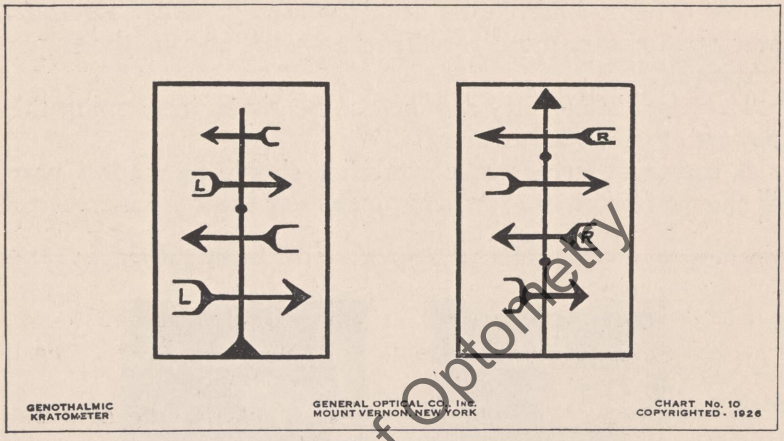


Chart No. 10

Daily exercises with these three charts should be given to every patient. These develop fusional desire, swift motility, sense of distance and speed. If stereopsis is lacking, it can be developed more rapidly and more surely with Kratometer exercises than by any method yet made known. When these stereoscopic exercises are used in addition to the routine duction exercises with a single target, the patient will develop the desired functional abilities of binocularity very rapidly.

EXERCISES FOR INCREASING CONVERGENCE RELAXATION

INCREASING the amount and the speed of binocular abduction in cases of esophoria will free the patient from headache. Exercises are given with prisms base in, for prisms in this position inhibit the innervation of convergence.

Furthermore, as these exercises proceed, they tend to break down the synergistically equal innervation of accommodation and convergence, which in this type of cases is undesirable. Following this, the latent hyperopia becomes manifest and can be corrected.

These same exercises are to be given in cases of accommodative, or pseudo, myopia, with the same purpose in view, the separation of the allied convergence and accommodation that has brought on the myopia. In these cases, the purpose is to build up convergence relaxation so that prisms base in can be prescribed for constant wear in lieu of minus lenses; in other words, to return the eyes to their normal condition of emmetropia or low hyperopia with little convergence needed, the convergence requirement being offset by the base in prisms.

In all cases of progressive myopia, give exercises to increase convergence relaxation, and prescribe prisms, base in.

In those cases of exhaustion resulting from the habitual covering of latent hyperopia and latent exophoria, give relaxation exercises, for these will break up the too closely knit association of convergence and accommodation, and make possible the prescription of the needed full plus correction.

Convergence relaxation exercises should be given at both distance and near. At the distance, use Chart No. 1, or a large letter or picture as fixation target. For the near point exercises use stereo-charts, such as Charts 5 to 9, as well as

exercises with a single target such as Chart 11, or any similar small picture.

Give convergence relaxation exercises with the full correction in the rear lens cells. Often, placing +0.50 D. or +0.75 D. spheres in the front cells will prove helpful. In presbyopia, the presbyopic addition must be placed in the rear cells while exercising at the reading distance.

Suspenopsia is seldom found with accommodative esophoria, but is frequently met in myopia. In cases of suspenopsia, use Charts 3, 5, 6 and 7, as directed under "Exercises for Suspenopsia."

Suppression is frequently met in esophoria, and can be treated with the same methods as suspenopsia.

Since the purpose of these exercises is to educate in the convergence centers *the habit of relaxation*, and the formation of any habit depends on the frequency of repetition of the act, we need to make as many successive prism jumps as possible. Since repression of the accommodation will assist in increasing the convergence relaxation, we should give these exercises with a little more plus added to the distance correction. This extra plus is placed in the front cells, so that these supplemental lenses may be inserted or withdrawn at will, without loss of time or disturbance to the patient.

If the convergence relaxation is only 3△ or 4△, begin exercises with rotary disks and prism slides in position as at the beginning of the abduction test, 5△ base *in* from both disks, 5△ base *out* from both slides. Reduce the power of the prism slides, moving the slides alternately, 1△ at a step. Go within 1△ of the blurring point, but try to avoid causing diplopia. Then reverse the slide movements, increasing the power base out and working up considerably past the zero point until some 5△ or 6△ base out is before each eye. Then start in the reduction once more and work down to the same point as formerly. Repeat this up and

down movement ten or twelve times. Rest a minute and repeat. At the beginning, allow a second or so between each jump of the slides. As you approach the breaking point, it is well to allow even more than this, allowing time for recovery between prism changes.

After a time, make an effort to increase, by 1 △ or 2 △, the amount of prism that can be overcome. Tell the patient to make an effort to bring the images together into one, in case diplopia occurs. As the lessons proceed, he will more successfully re-fuse the broken image.

As a variant, give exercises at the reading point with the stereo-septum in place, using Charts Nos. 5, 6, 7 and any others of similar type that may be at hand. Description of these exercises is detailed in the sections devoted to suspenopsia.

As described fully in the section on the abduction test, watch constantly for possible suppression or suspension.

Also, give exercises with the vertical prism slides as described under "Vertical Exercises."

Never omit the "Exercises in Motility and Speed of Adjustment" as outlined in that section.

Occasionally, a case will be found with no reserve abduction. Exercises will then have to be commenced with considerable prism power base out from the horizontal slides, anywhere from 5 △ to 10 △ before each eye, and the power reduced, step by step, to zero. At the beginning, it may be impossible to reduce even to zero power. Perseverance will break through this habit of inhibition to the external recti, and after a time they will be given the required innervational impulses, so that an abduction ability will be built up.

At the beginning, the base in increases of power should not be made too rapidly. Allow a second or more between jumps. But the decreases in power can be made as fast as one wishes, with a scarcely perceptible pause between the jumps.

It is not advisable to let the mind of the patient realize that two images can be seen by the simple means of ceasing the effort to see singly. Keep before the patient the idea that he must see ONE image. Do not increase the power to the breaking point.

As soon as the patient becomes accustomed to the pulling outward effect of the base in prism increases, begin to move the slides more rapidly. In the lower steps you can soon work up to quite a rapid gait, but as the power increases, allow slightly longer pauses between each jump. Occasionally, make a trial of one extra step over one eye only, to see if you can force a little more relaxation without diplopia. If this succeeds, include this extra step in every turn, and as soon as possible try to get in another extra diopter.

It is seldom that much increase in speed or amount can be accomplished during the first few days. But on each day try to work a little faster and go a little higher.

In exercises for esophoria and accommodative, or pseudo, myopia, remember that the aim is to awaken innervation of the external recti, with corresponding inhibition of convergence.

The purpose of the exercises is attained in both true and accommodative esophoria when the convergence relaxation and dissociation from accommodation has reached the point where the full plus correction is accepted without blurred vision, when the abduction is at least four times greater in prism units than the amount of any esophoria still manifest, and when the accommodation accepts sufficient repressive plus lens power to make a showing of accommodative orthophoria, or at least, a very great reduction of accommodative esophoria, at distance. And in myopia we have accomplished the desired result when a notable reduction of minus lenses (either with or without prism base in), or the substitution of plus for minus (with or without prism base in) is accepted for distance vision.

EXERCISES FOR INCREASING ADDUCTION RESERVE

To be made at distance. Use Chart No. 1, or any picture or fairly large object. In some cases, a light serves very well; for other people it is not as good as a letter or picture.

Adjust pupillary distance of batteries for 4 to 6 mm. less than the patient's P. D. Set prism slides in brackets with prisms base *out*.

The object of these exercises is to accustom the nervous centers to withdraw innervation from the external recti and permit these abducent muscles to relax.

Therefore, this purpose is best served by repeating as many times as possible the jump that will make convergence necessary. Where the adduction reserve is very low, it is necessary, in order to get this frequent repetition, to start below zero, with 6△ base *in* (occasionally as much as 10△) from the rotary disks. If the adduction test shows only 8△, this gives us only 4 jumps from each prism slide. By starting with 3△ base *in* from each rotary disks, we can get 7 jumps. We are striving to create an innervational habit, and habits are formed by frequent repetition of the same act.

Whatever the amount of reserve adduction in the initial exercises, do not carry the prism power quite to that point. Do not cultivate in the patient's mind the habit of "letting go," of relaxing the effort and seeing double. Keep ever before the patient's mind that he MUST SEE ONE IMAGE.

For the most part, advance the prism slides together. For the sake of variety, occasionally one of the Slides may be used alone, but this is to be followed at once by the use of the slide on the other eye. Our intent is to awaken responsiveness in the field of versions, surrounding the macular field. We must incite the nervous elements of both eyes to gain this end.

Increase the prism power 1 △ at a step for each eye almost to the breaking point as shown in the adduction tests. Then decrease the prism power at the same rate back to zero, then up again, down again, repeating the up and down movement 10 or 12 times without pausing for rest.

At the beginning, a pause of a second, sometimes more, is to be made between each jump, to permit nervous recovery. After a few days, an attempt can be made to shorten the pause. The length of the pause should conform to the patient's ability, physical strength and condition.

Always avoid fatiguing the patient. Those who are not physically robust should be treated with much care. A woman with digestive troubles can be very easily upset if the exercising is overdone. In such cases, often, at the beginning, a pause of two or three seconds between jumps is necessary. And in such cases, sometimes, one or two up and down turns is all that can be tolerated without nausea.

Over exercising at the beginning is apt to cause severe headaches and much distress. More is to be gained by beginning slowly and gently. When a little work can be done without causing exhaustion, the amount of effort called forth can be increased. As a rule, five minutes of exercising each day is quite sufficient. In some cases, two or three minutes is the maximum of safety.

Work first to increase the ease of performance in that amount of adduction that the patient has. Then work for speed in the use of this same amount. When the exercises can be conducted without fatigue, nausea or headache, then begin to work for an increase of amount, but not until then. Increased amount will come very quickly after practice has created the ability of handily using the lower quantities.

Sometimes, the amount of adduction cannot be at all increased, but if we teach the patient to use easily the amount of duction and version he already has, we shall add wonderfully to his comfort and working capacity. A high reserve is

undoubtedly of great assistance, but the quality of the innervational resource is of greater consequence than amount of adduction.

Warn the patient that during the first few days he may expect some headache, and peculiar sensations in the head, and around the eyes. Tell him not to worry about that, for it will soon disappear under regular exercise.

After the patient has learned to overcome the full power of the prism slides, additional base out prisms can be turned in from the rotary disks, and the up and down movements of the slides continued as before.

In working up more power, advance one slide at a time, alternating between the two eyes. If diplopia results, tell the patient to make an effort to bring the two images together into one. Insist that he make the effort. But this is not to be done until he can handle the lower power with speed and ease.

Sometimes, in making a great effort to maintain single vision, a spasm of the convergence is induced. Then when the prism power is reduced, relaxation of the interni does not follow, and the patient sees double with the lower power prisms although he saw singly with the higher power. For example, a patient may have an adduction of 23△, and we repeat several times the call for 23△ of extra convergence. If that 23△ was only obtained through a supreme effort of the will, he will maintain single vision with 23△, but the image will break at 22△. It is not well to overtask the convergence at any time. Do not call for so much energy that untoward results will occur.

We occasionally encounter a case where, after working up to the full adductive ability and then decreasing the prism power, the single image is held until we return to zero or to within 1△ or 2△ of zero, and then diplopia occurs. This is due to slow responsiveness in the central nervous system, to sluggish adjusting ability. In these cases, always move

the slides more slowly when approaching zero, until the nervous centers have been well educated to quick response to the call for adjustment.

Just as there is occasional suspension of vision, which is really loss of attention on the part of the secondary, or brain, visual centers connected with the suspending eye, so is there occasional lapse of version due to inattentiveness of the version centers. A person may have a reserve adduction of 20△ or 30△, yet sometimes diplopia may occur at any lower power. If such a patient says, "Two", while the slides are being advanced, simply pause and say, "Make it one." This he will promptly do, and when the attention of the version centers is thus recaptured, slide advances are continued. In treating this type of case, the aim of the exercises is to cultivate the habit of continued attention from the version control centers. They must be taught the habit of constant and unremitting attention to their task.

As in the adduction tests, always keep before the patient's mind that he is to speak immediately if the object seems to move to one side, or if he sees two images instead of one. Some people are not good at keeping the operator promptly advised, and these must be strongly urged, for their own benefit, to speak immediately when they see two objects or when the object seems to move sidewise.

From the beginning, give exercises with the vertical prisms as well as the horizontal.

After a week or so (the time depending on the seriousness of the case and the results being obtained) commence exercises in adjustments at different positions, as described under that heading.

Exercises at the near point should also be given. But in very bad cases, these cannot be undertaken at first.

In convergence exercises always return to zero before permitting the patient to withdraw from the instrument. This to avoid dizziness and nausea. In very bad cases, especially

if the digestion is involved, permit the patient to remain seated three or four minutes after concluding the exercises, before attempting to walk.

These exercises are to be given with the distance correction, if such is worn, in the rear lens cells. There is a distinct advantage to be gained, if the accommodative amplitude is also low, by putting -0.50 or -0.75 spheres in the front lens cells. But this should not be done in those cases where the full plus correction increases the exophoria, and the purpose of the exercises is to develop convergence independently of accommodation.

Usually, after two or three weeks of regular Kratometer treatments, the patient will voluntarily remark that his eyes are more comfortable. Exercises should be continued for a week or ten days after all disagreeable symptoms have vanished.

Do not discontinue the exercises until the slides can be moved up and down with extreme rapidity without causing diplopia, nausea or fatigue.

Under no circumstances must exercises in adduction be given in cases of esophoria or myopia, for this would increase the patient's trouble. Give convergence relaxation exercises to esophores and myopes.

EXERCISES FOR DEVELOPING AMPLITUDES AND ASSOCIATION OF ACCOMMODATION AND CONVERGENCE

MANY young people come to the refractionist complaining of difficulty with near work, especially students, stenographers and others who spend all day at very close work. A slight refractive error may be found, or no error at all. But the reading point tests show the necessity of plus lenses as an aid to clear vision, and the amplitudes of accommodation and convergence are low. These have been classed as "Premature Presbyopes."

These young people are not presbyopic, but their innervational resources are low and their innervational reflexes and responses are poor. Instead of giving these young people "special reading glasses," with plus lenses that will tend to repress and still further weaken the accommodative function, give them exercises for ten days or two weeks with the Kratometer Prism Jump System.

The exercises are at the near work distance. Use Chart No. 11, and prepare other similar cards, pasting small pictures, stamps, seals, etc., on white cards. This gives a variety, which helps to awaken and sustain interest. The exercises are given in the same manner as the exercises for convergence insufficiency, excepting that no time need be spent on the distance exercising. Ten to fifteen minutes daily can be spent, and there is rarely any after effect of headache or nausea. If time and opportunity afford, two sessions a day can be given.

Use also stereo cards, and the exercises at different positions as described in other sections.

This is decidedly a better way of treating those cases than imposing on them the burden and annoyance of glasses. A great many times, innervational habits can be educated that will render unnecessary the correction of slight structural refractive errors.

The same treatment is to be given to early presbyopes, whose required reading addition is in excess of that normally to be expected at their age, excepting in esophoria cases.

The use, part of the time, of -0.50 and -0.75 spheres in the front lens cells is advisable.

EXERCISES FOR THE RESTORATION OF BINOCULAR FUNCTIONS

One of the most troublesome symptoms arising in the course of such diseases as high blood pressure, toxic infections from diseased sinuses, tonsils, teeth, etc., is the loss of associated control of muscles that are normally synergistically innervated.

Innervational ocular exercises cannot be given to patients while they are suffering from these diseases.

Often, after the progress of the disease is stayed, and after recovery is apparently complete, binocular imbalances persist.

Then a course of Kratometer exercises will prove highly beneficial. Often suspenopsia appears, and to those suspenopsia exercises should be given. And exercises as in convergence and accommodative insufficiencies are to follow. The operator must carefully guard against over-exercising these cases.

Among other beneficial results, these exercises incite the circulation of the blood. Toxins and debris that have accumulated will be pumped out and carried away. Muscular tone is recovered, together with the innervational habits that were lost because of disease.

EXERCISES IN MOTILITY AND SPEED OF ADJUSTMENT IN VARIOUS POSITIONS

Many workers, such as typists, bookkeepers, certain machine operatives, etc., are troubled at their work, not because of lack of accommodative or convergence amplitudes, but because of slow motility and lagging adjustments. They are unable to quickly transfer vision and binocular functioning from one object to another.

Many motor accidents are due to slow reflex adjustments. The trouble is not visual, there may be normal macular

vision and full efficiency of the peripheral fields. The one thing that is lacking is quick adjustment.

In all cases of suspenopsia and suppression, motility and quick adjustment are characteristically lacking.

These exercises in motility and adjustments for different positions, which are easily and efficiently carried on with the Kratometer, are impossible with any other apparatus yet devised.

After the possibility of suspension is eliminated, these exercises should be instituted.

For motility exercises at distance use Chart No. 1, or a picture or letter. For near work use Chart No. 11, or a similar picture.

Put the proper correction in the rear lens cells. Adjust the pupillary distance. Set the rotary disks at ZERO. Insert the horizontal prism slides in the brackets, with prisms base out.

With the patient in comfortable position, push the right slide down to 13△ base *out*. Both slides now extend below the batteries. The right slide is at 13△ base out, the left slide is at zero. The right eye is turning in considerably, while the left eye is converging but slightly. Push both slides up, one notch at a time, and not too rapidly at first. As the slides move upward, the left eye is drawn inward while the right eye, step by step, relaxes its convergence. At every step the comparative positions of the two eyes change. When the prisms are half-way up, both converge to the median plane. Beyond this, the left eye converges more, the right eye less.

When the slides have passed their entire length, reverse the movement, work all the way down, then return up, and continue this through ten or twelve turns.

As the slides move upward, the object seems to hop to the right; as the slides are drawn down, the object seems to travel to the left. At every one of these jumps of the position

of the object, the eyes must make a new adjustment of accommodation and convergence.

When the patient has become accustomed to this movement, so that the exercise can be given at a very rapid rate, without causing dizziness, various other positions may be brought about by turning in prisms from the rotary disks.

Turn in 5△ base out over the right eye, and exercise. Then turn in 5△ base in from the left eye, and repeat the exercises. This turns both eyes to the left. Then turn in 10△ base out over the right eye, and repeat the prism slide movement. Then 10△ base in from the left disk. The eyes are now being exercised while turned far to the left. Then 15△ base out from the right disk, which brings about exercises at still another position.

The same series of exercises are to be performed with both eyes turned to the right, starting in with 5△ base out over left eye, then 5△ base out over left and 5△ base in over right, then increasing the right disk prism to 10△, next bringing the left disk prism up to 10△, and finally the left up to 15△.

Between each change of disk prism power, the up and down movements of the slides are to be repeated from six to twelve times. Do not hurry the speed at first, but finally a very rapid gait can be set up, the slides being moved up and down with no stops at the notches.

Exercises with the vertical prism slides are to be given in the same way, with different combinations of prisms from the rotary disks. Use 3△ both base in, 3△ both base out, 3△ base out with 5△ base in, 5△ both base out, 10△ both base out, 5△ base in with 10△ base out, and so on in almost infinite variety.

Turn in 5△ base up from both disks, and give the exercises with the horizontal prism slides. Then turn the 5△ disk prisms over to base down and repeat the exercises. This is much more difficult than with the disk prisms both

at base up. Also, give the exercises with 10△ base up from both disks.

It is impossible to set down all the combinations that can be worked out for turning the eyes into different positions and educating them to make rapid adjustments whenever and in whatever position may be required. Suffice it to say that these exercises are fully as important as the exercises whose sole aim is to develop more adduction reserve.

But this must be added, that the higher the reserve adduction, the greater variety of these motility exercises that can be given. Where the adduction is high, it is possible to give these exercises with as much as 25△ base out from one rotary disk with zero from the other.

Exercises in convergence relaxation with the horizontal slides at bases in, and exercises for increasing convergence with the horizontal slides at bases out, should also be given with both eyes turned to the right, by using 5△ or 10△ base in from the right rotary disk and 5△ or 10△ base out from the left rotary disk, as described in preceding paragraphs. Likewise, the same exercise is to be given with both eyes turned to the left with the proper arrangement of the rotary disks. And add further variety by turning both eyes upward and downward, using 5△ from both rotary disks at base down, and with both at base up.

VERTICAL EXERCISES

The vertical muscles are to be exercised daily even if no vertical disturbances are manifest. For such exercises increase general ocular motility and greatly shorten the time that is to be spent in building up horizontal reserves.

If the reserve vertical ductions are not above 3△ or 4△, give particular attention to their development. A reserve vertical diction of 6△ to 7△, binocularly, can be developed, and is a great asset to the person possessing it.

If suspenopsia is present, use Charts 4, 5, 6, 7 and 8 with the vertical horizontal slides.

If there is no suspenopsia, use Chart No. 11.

For the exercises, adjust the instrument as in taking the vertical ductions. In exercising, work for speed in overcoming the lower powers before attempting to increase the amount. Do not advance the power to the blurring point, but stop at one or two steps below that point and return to zero.

Exercise the right inferior rectus against the left superior rectus by using the right vertical slide at base up and the left vertical slide at base down.

Exercise the left inferior rectus against the right superior rectus by using the left vertical slide at base up and the right vertical slide at base down.

Thus the prism apex is always over the muscle whose innervation we are inciting, that is, the direction in which we desire to increase duction.

Give these vertical exercises with the rotary disks at open, and with various combinations of base out and base in prisms from the rotary disks, as described in the section on "Exercises in Motility and Speed of Adjustment in Various Positions." The importance of vertical exercising with varying amounts of convergence in use, and with the eyes turned to right or left, cannot be over-emphasized.

TREATMENT OF HYPERPHORIA

If hyperphoria is manifest, before attempting its correction make sure that it is not caused by high blood pressure, or from focal infections, such as decayed teeth, diseased tonsils, adenoids, nasal passages, sinus disease, or other toxic conditions.

If sure that it is a true hyperphoria, do not give vertical prism with the base "over the weak muscle." This may

give a little temporary comfort, but it will eventually lead to further weaknesses and will finally result in loss of equilibrium. The way to treat hyperphoria is to build up equality of vertical ductions.

Give exercises only in the direction of the weak innervation. If the duction tests show that the antagonistic ability of the right inferior rectus against the left superior rectus is greater than that of the left inferior rectus against the right superior rectus, exercise the latter pair only. Or if the reverse is the case, if the right inferior rectus against the left superior rectus shows the lower duction, the exercises are to be confined to this pair.

If the left eye shows a tendency to turn up, or the right eye shows a tendency to turn down, it is because there is insufficient innervation to the left inferior and the right superior recti, with proportionate over-innervation of their antagonists, the right inferior and left superior recti. Inhibit the innervation of the latter pair and incite the innervation of the first pair by exercises with the right vertical slide at base down and the left vertical slide at base up.

If the right eye shows a tendency to turn upward, or the left eye shows a tendency to turn downward, it is because of insufficient innervation to the right inferior and left superior recti with over-innervation of their antagonists, the right superior and left inferior recti. Inhibit the latter and innervate the former by exercises with the right vertical slide at base up and the left vertical slide at base down.

These exercises develop in the central nervous system the habit of properly distributing innervation and inhibition, so that the tendency to hyperphoria disappears.

A desirable addition to daily exercising of the verticals, when ductions are unequal, is the prescription of a weak prism for constant wear with the apex in the same direction as the exercises are being given. It is usually better to divide the power equally between the two eyes. Such prism is

to be discontinued when the exercises have built up equality of ductions.

Vertical ductions and exercises must always proceed at a slow rate, with ample pause for recovery between each prism jump. Postpone attempts to increase speed until response becomes steady and sure.

EXERCISES WITH THE SLIDES AT OBLIQUE ANGLES

An addition to the motility exercises is the use of the horizontal and vertical slides tilted obliquely. Loosen the set screws (12–12) of the adjustable brackets and turn the upper ends of these brackets toward each other about 5 degrees. Insert the horizontal slides, bases out, and give the convergence and other exercises described in previous pages. After a few turns with these, insert the vertical slides and repeat former exercises.

Then turn the brackets so that the upper ends are tilted away from each other about 5 degrees and repeat the exercises, using both horizontal and vertical slides.

In giving exercises for convergence insufficiency, tilt the upper ends of the adjustable brackets about 10 degrees inward and use the horizontal slides with bases out. When the brackets are tilted as much as this, use the slides in alternation, otherwise they interfere with each other. Five or six turns to each eye, then tilt the brackets a little more, to about 15 degrees. Absolute accuracy in the degree of tilting is unimportant.

Convergence is normally both inward and downward, the inferior recti participate to no inconsiderable degree. These exercises with the slides in oblique position, develop the convergence ability very rapidly.

In esophoria and myopia, where we seek to develop convergence relaxation, use the brackets in the same positions

as above, but turn the horizontal slides to base in. The apex is then out and up, and the innervation is thus driven away from the association of internal and inferior recti.

EXERCISES FOR DEVELOPING FUSIONAL SENSE AND DESIRE

MANY individuals suffer visual inconvenience from incomplete development of the fusional centers. There are no muscular faults nor innervational incompetencies. Versions are good, but there is some visual discomfort, and duction reserves are low, merely because the desire for the single image is uncultivated. The use of Charts 5 to 10 will develop the fusional sense much more rapidly than the use of the single target.

EXERCISES FOR SQUINT

IT is doubtful if exercises alone will straighten the eyes in either convergent or divergent squint. But by developing the desire for fusion, or by retarding the loss of that desire, and by the development of visual acuity, or by retarding the onset of amblyopia ex anopsia, the refractionist will find his task made much easier by giving exercises with Charts 5 to 10.

There may be some difficulty in so adjusting the prisms as to place the images on both eyes within the fusional areas, but the Kratometer is susceptible of so great a variety of adjustments that few instances can arise in which such positioning is impossible.

After this combination of positioning prisms is found, proceed to jump the slides, one step at a time, pausing for several seconds between each step to give plenty of time for recovery of nervous conduction and recognition of the test object. With the horizontal slides work in both directions, increasing and decreasing prism power. And with the vertical slides work for both supra- and infra-ductions. Make no

attempt at many steps in the beginning. Be content with adding one or two steps per day to the motility.

In convergent squint, the most of the effort should be directed toward increasing abduction. In divergent squint, try to build up response to the call for adduction. Guard constantly against suppression or suspension.

EXERCISES AFTER CORRECTION OF SQUINT

After the squint is overcome, by either glasses or operation, the refractionist's duty is not completed until the pair of eyes has been taught to function binocularly.

There are plenty of instances where the squinting eye straightens on the application of the repression of the plus correction to convergent squint, but the formerly squinting eye does not take up the act of vision. Instead, it suspends most of the time, and the visual centers never learn the secret of fusion with the images presented by the other eye.

If this eye is amblyopic, give exercises for the development of acuity as described in another section.

Give daily exercises to overcome the habit of suspension. When acuity and freedom from suspenopsia are well developed, begin exercises to develop the sense of stereopsis.

Do not discontinue these exercises until the patient is in full possession of all the functions and advantages of binocular vision.

SECTIONAL ASTIGMATISM

Sectional astigmatism, or meridional contraction of the crystalline, will give way to exercises in convergence relaxation.

Also, in those cases in which the accommodation covers part of the astigmatic error, so that the patient will accept but a part of the true cylindrical correction, relaxation of the

convergence and dissociation from the accommodation may be brought about by Kratometer exercises with prisms, base in.

When the patient will not accept the cylinders indicated by the ophthalmometer as needed in correction of the corneal error, and, as is often the case, even skiascopic findings fail to reveal the astigmatic error, give exercises in convergence relaxation, then refract the case with base in prisms in the Genothalmic Refractor. Sometimes sufficient relaxation can be obtained in a single examination by this method to enable the patient to accept with satisfaction the desired cylindrical correction. Such exercises should also be given before the finished glasses are adjusted, and frequently may be repeated daily for several days.

The astigmatism must be corrected in full or trouble will be experienced in the cross-cylinder check tests. The following procedure is often effective: Use the Kratometer with Chart No. 2 set at the reading distance. Using the horizontal slides with their prisms base *in*, relax the convergence to the utmost, leaving all the prism in place that can be tolerated without diplopia. Overcorrect the astigmatism in both eyes by at least 1 D. of plus cylinders, so that one set of lines is decidely blacker than the other. In astigmatism with the rule, the horizontal lines will come out the stronger; against the rule, the vertical lines will be blacker. Then reduce the cylinders by eighth-diopter steps until both sets of lines are of equal blackness. The cylinders left in place will be found to closely approximate the expectation from the ophthalmometer readings. The test is made with both eyes uncovered. Check each eye separately by quick occlusion of the other. Prolonged occlusion will permit the convergence and associated accommodation to reassert themselves, which must be avoided.

In non-presbyopes with low hyperopic error, this correction is to be made without spheres, the spherical correction

being determined by the cross-cylinder method. In presbyopia or high hyperopia, some plus sphere must be used to give vision of the chart.

If the full plus astigmatic correction should increase the amount of exophoria, as it frequently does, it may be necessary to prescribe for temporary use some prism base in to hold the convergence in check, and to give relaxation exercises with the Kratometer to break down the association of convergence and accommodation.

Sometimes, in cases of simple hyperopic astigmatism, after the astigmatism has been fully corrected, it may be necessary to use weak minus spheres to secure binocular balance and clear, comfortable vision.

Sectional accommodation is met in almost all cases of esophoria and quite frequently in myopia.

Frequently, what seemed at first a slightly oblique axis, will be found vertical after the convergence-accommodative strain has been relieved. An axis of 85, 80, 95 or 100 will right itself and come to 90 after the sectional accommodation and the convergence effort that caused it have been repressed.

OBLIQUE ASTIGMATISM, TORSIONS AND CYCLOPHORIA

In oblique astigmatism, there is often considerable doubt as to whether the cylinder axes found in the monocular test are correct binocularly. To check these axes use Chart No. 3, set at 35 cm., and with the stereo septum in place. Leave the rotary discs at open and insert the horizontal prism slides with bases out, set at the zero openings. Insert the correction found in the rear lens cells.

Direct the patient's attention to the squares of horizontal and vertical lines, first to the right squares, occluding the left eye, then to the left squares, with the right eye occluded.

If the cylinder axes are incorrect, the lines, instead of appearing true, will be zig-zagged. Adjust the cylinder axis until the lines are true. This is the monocular check.

Adjust the horizontal slides to that power which in the phoria test was found to fuse the E. If the cylinder axes are binocularly correct, the lines will appear true, but if there is a torsion, the lines will be zig-zagged. Adjust the cylinder axes until the lines are true. Sometimes the zig-zag effect is due to incorrect cylinder strength, and this will have to be modified. This check test will prove the correctness or incorrectness of the cylindrical lenses when the eyes are functioning binocularly, and that in a manner that leaves no room for doubt.

Oblique astigmatism and torsions are so commonly associated that monocular astigmatic corrections are usually binocularly at fault. With the special Kratometer stereophoria and ductions tests, the tendency to these torsions is at once disclosed, and the refractionist is placed on his guard.

In using Chart No. 4, when the line of horizontal dots breaks into two lines, if there is a tendency to cyclophoria, one or both lines will turn from the horizontal to an oblique position, forming an acute angle.

If such evidence of cyclophoria is found, and there is complaint of ocular discomfort, it will also be found that there is either imbalance between convergence and accommodation or that there is a convergence insufficiency or that the vertical ductions are unequal.

In using Chart No. 3, sometimes one or the other of the letters will appear higher than the other and the patient will see one of them in a tilted position. This is evidence of cyclophoria, and often a cyclophoria will present all the evidences of hyperphoria.

The proper procedure is to establish innervational balance in binocular functions. Make sure that accommodative and convergence requirements and efforts are equalized. Develop

equality of ductions in the vertical antagonists, and speed and surety of adjustment in the versions by the exercises given in preceding pages. Particular attention to the cyclophoria itself is seldom necessary.

So long as the innervational resources are sufficient to care for structural errors, the errors in themselves are of comparative unimportance.

One who wishes to study torsions and cyclophoria in detail, will find an ideal apparatus in the adjustable stereo features of the Genothalmic Kratometer.

The experimental use of the Kratometer in the study of those peculiarities known as cyclophorias, torsions and declinations, will soon convince the thoughtful mind of the utter futility of the much advocated exercises with "Swinging Cylinders" or the prescription of oblique cylinders. Innervational exercises in motility in all directions, given under the Kratometer system, will very quickly educate the innervational centers to care for any torting tendencies, and that without undue "muscular" effort or strain.

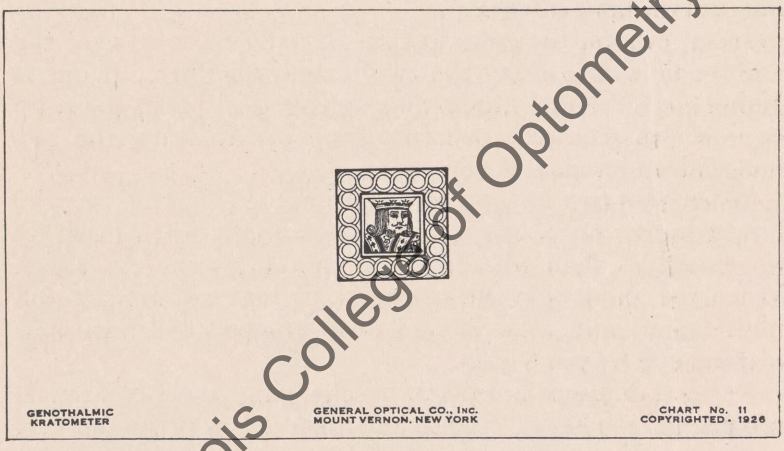


Chart No. 11

AMBLYOPIA EX ANOPSIA DUCTIONS AND FUSION AND VISUAL EXERCISES

USE Chart No. 11. The border is red with the central figure black. This chart is not only to be used in the exercises below with a red glass, but is used as fixation object without the red glass in the various tests and exercises described in previous sections.

Set this card on Kratometer rod at the usual reading distance, 35 to 40 cm. from the eyes, and insert reading correction in rear lens cells.

Place red glass over the good eye. This eye will now see the red border of the target as a very pale pink, while to the amblyopic eye the border will appear its natural bright red.

Call patient's attention to the two targets he sees, the pale pink by the good eye, the bright red by the amblyopic eye. If he does not see the bright red target, cover the good eye so that the attention of the amblyopic eye will be captured. Then uncover good eye, and he will probably hold both images. If not, cover and uncover good eye rapidly until he does retain both images.

Insert enough horizontal prism (usually base in) over the amblyopic eye to bring the two images together. If one is higher than the other, insert enough vertical prism (base up or down as required) over the good eye to bring the two images into horizontal alignment.

When the two images are superimposed, he will see the bright border only, but it will be less bright when fused by the two eyes than when seen by the amblyopic eye alone. When the amblyopic eye suspends, patient will see the dull pink target only. Cover and uncover good eye until amblyopic eye retains vision.

Vertical ductions are taken by changing power of vertical prism over good eye. Steps cannot exceed ¼ prism diopter.

Horizontal ductions are taken by changing power of hori-

zontal prism over amblyopic eye. Steps cannot exceed one prism diopter.

Exercise by changing prism power over amblyopic eye only. Often not more than one diopter change can be made at first without causing diplopia. Shift prism power back and forth within the limits of single vision, three or four seconds' time interval between each change. Never go to the point of double vision. Watch for suspension by amblyopic eye. Two or three minutes of this exercise daily are sufficient. Do not cause fatigue. After a few days, it will be found that the number of steps can be increased, and the time interval between jumps can be shortened.

After a few minutes of this exercise, cover the good eye, and have patient read with the amblyopic eye alone for a few minutes. If vision is very poor, use the advertising pages of magazines, and let him pick out such letters as he can see or guess at.

Daily improvement in acuity and fusional desire will be noticed. Check correcting lenses frequently and change as necessary. The amblyopic eye, as acuity increases, will doubtless need several lens changes before final correction is established. As fusional desire improves, it will usually occur that vertical prisms are no longer needed.

Similar card on larger scale may be used for distance ductions.

Acuity develops more rapidly under the Kratometer innervating impulses than by any other method. Surprising results are attained. We have many instances on record where eminent specialists have stated that nothing could be done in the way of improving vision in amblyopic eyes, yet with Kratometer exercises vision has been brought up to normal in a few weeks. We have such records of developed vision in adults of from 30 to 50 years of age.

Distinguish between amblyopio ex anopsia and amblyopia because of disease, as high blood pressure, diabetes, etc.

ACCOMMODATION-CONVERGENCE BALANCE

THE CROSS-CYLINDER CHECK TEST WITH THE KRATOMETER

THE prime essential of Binocular Balance is the equality of effort in associated and synergistically innervated accommodation and convergence. The function of lenses and prisms is to bring about this balance.

Over-correction of hyperopia with exophoria may bring about imbalance. The careless prescription of prisms in the correction of exophoria may bring about imbalance. Visual tests alone will not give information as to the correctness or comfort-giving qualities of lenticular prescriptions. The old rule to deduct "about 0.50 D. or 0.75 D. sphere" from the accepted monocular corrections in hyperopia with exophoria is abhorrent to the refractionist who seeks precision. The rule to give prism to the amount of "about one-third to one-half of the manifest error" in exophoria is but crude guess work.

The following procedure provides an adequate check against failure in leaving a delicately adjusted balance between convergence and accommodative requirements, and will show just what prism, base in, if any, is required.

With the cross-cylinder in place over a correcting lens or combination of lenses, the correction is exact if the cross-cylinder makes a slight blur, and an equal blur, of the horizontal and vertical lines of Charts Nos. 1 and 2.

The slight blur is necessary, otherwise the test is of no avail. Since different retinae have an apparently different "depth of focus," one and the same strength of cross-cylinder will not serve for every eye. The following four pairs of cross-cylinders must be prepared and mounted in trial rings to fit the front lens cells of the Kratometer.

No. 1. −0.25 Sph. ⌒ +0.50 Cyl. Ax. 180.
No. 2. −0.50 Sph. ⌒ +1.00 Cyl. Ax. 180.

No. 3. −0.75 Sph. ⌒ +1.50 Cyl. Ax. 180.
No. 4. −1.00 Sph. ⌒ +2.00 Cyl. Ax. 180.

In use, these cross-cylinders are always set with the plus axis at 180.

Before attempting to use the cross-cylinder check, make sure that the patient sees all the vertical and horizontal lines of the cross equally clear. Astigmatism must be corrected in full. In some cases of high blood pressure, focal infections, incipient cataract, and in many cases of undeveloped retinal terminals, the lines cannot be made to appear equally clear. In that event, do not attempt to use the cross-cylinder check for accommodative-convergence balance.

Next, by a quick test, find what power cross-cylinder will produce a slight blur. In cases of high visual acuity, and especially in accommodative esophoria with small pupils, the higher strength cross-cylinders will be necessary. In low visual acuity, in myopes, in exophoria with large pupils, the lower powers will prove better. Many times, different powered cross-cylinders must be used on the two eyes.

In all essential features, the distance and near corrections are checked in the same manner, and the following notes apply to both:

Arrange the Kratometer as in the phoria test, the batteries set at the correct interpupillary distance for either near or distance vision as the case may be. The horizontal prism slides are inserted in the brackets with prism bases in, and set at the zero openings. Turn the *left* rotary disk to 3△ *base down* and the *right* rotary disk to 3△ *base up*, or to whatever other combination of right and left prisms was found, in the phoria test, to produce vertical diplopia. Remember that the upper cross belongs to the left eye and the lower cross to the right eye.

The correction, as found by other objective and subjective methods is placed in the rear lens cells.

Direct the patient's attention to the lower cross (right eye) and inquire if the horizontal lines are blacker and clearer than the vertical, or if the vertical are the blacker, or if both sets look equally blurred.

Make the same inquiry as to the upper cross (left eye).

If the horizontal lines are blacker, plus sphere is to be added. If the vertical lines are blacker, plus sphere is to be deducted.

In adding or subtracting plus for either eye, if the accommodation is active, it is probable that the appearance of the lines will be changed for the other eye. Add or subtract plus to equalize the appearance of both sets of lines to both eyes.

If there is a manifest exophoria, insert prism, base in, from the horizontal slides, of equal amount to both eyes or as nearly equal as possible, until the two crosses are in vertical alignment. This prism is not to be included in the final prescription. But if the horizontal lines are plainer to one or both eyes and the addition of more plus sphere to equalize the lines should move the upper cross to the right, ever so little, the latent exophoria is being revealed and extra prism, base in, must be added to once more bring the crosses to vertical alignment. This extra prism is to be made a part of the final prescription, for constant wear.

Very often, this addition of extra prism, in correcting the latent exophoria and thus relaxing the convergence, will also relax the accommodation, revealing more of the latent hyperopia. If this happens, the horizontal lines will come out black again. Add plus to equalize the lines and inquire if the upper cross has again shifted to the right. If so, add more base in prism. This is continued until no more plus can be added without making the vertical lines clearer than the horizontal, nor can more prism be added without shifting the upper cross to the left.

The full amount of the latent hyperopia can be uncovered by this method, and without the use of atropine. In fact,

this method usually reveals more latent error than atropine does, due to the fact that atropine cannot penetrate beyond the locked point of voluntary functional control of the convergence over the involuntary function of accommodation.

When the addition of base in prism does not make the horizontal lines appear blacker and plainer than the vertical lines, nor does the addition of plus spheres make the vertical lines clearer than the horizontal, the full static error has been uncovered.

In cases where there is a high convergence relaxation, the test may be made binocularly, without the use of vertical displacing prisms. If abduction is low, diplopia may occur before disclosure of the full error. But the attempt should always be made to check the monocular (with vertical displacing prisms) method against the binocular method (without displacing prisms).

In the monocular method, the patient is made to see two images, one for each eye, and where the static refraction of the two eyes is different, the true difference is here made manifest. Often, by ordinary skiascopic and subjective tests, the two eyes are apparently different, but by this cross-cylinder method it will often be found that the two eyes are equal. Again, ordinary tests may show the two eyes as similar, while they are actually not statically equal, as will be proved by the cross-cylinder method.

Therefore, the monocular method is to be used first, any proved difference in plus lens power is placed in the lens cells; then, binocularly, both eyes fixed on the one cross, prism, base in, and plus spheres, equal to both eyes, are to be added until neither the addition of sphere or prism will bring about an apparent difference in appearance of horizontal and vertical lines. Thus, the two methods check each other and verify findings.

When the question arises as to whether to give base in or base out exercises, the decisive answer is to be found by uncovering

the latent hyperopia. If this be more than 1 D., it will be safe to assume that any manifest convergence insufficiency is due to exhaustion from lack of sufficient plus correction, and base in exercises are to be given and more plus prescribed as quickly as possible. It may take several weeks of daily exercises and several changes of glasses before the needed correction is accepted with clear vision.

Where the latent error is less than 1 D., give exercises for convergence insufficiency with base out prisms.

In presbyopic cases where the reading addition is noticeably greater than the amount to be expected at the patient's age, we may justly suspect that the full hyperopic error has not been uncovered. The above method, in its combined repression of the convergence and accommodation by prisms and plus spheres, will make manifest and correctible both the latent hyperopia and the latent exophoria. As these are somewhat difficult cases to handle, many times, especially when the convergence and accommodation are very strongly associated, convergence relaxation exercises, as described in the preceding pages, will prove of great assistance in unlocking this association and making the latent exophoria and hyperopia manifest.

Base in prisms are not to be prescribed for any manifest exophoria, but must be given to correct any latent exophoria that is revealed as the addition of plus lenses, in correcting the latent hyperopia, makes this latent exophoria manifest.

After the monocular corrections are thus checked, proceed to a binocular check. Turn out the vertical prisms from the rotary disks, leaving the disks at open. If any manifest exophoria was corrected with the horizontal prism slides, reduce these slides by that amount. For example, if there was originally 4△ of exophoria, so that each prism slide was advanced to 2△ base in, and the addition of plus sphere so increased the exophoria that 1△ additional prism to each eye was required to realign the crosses, the horizontal slides

will each be standing at 3△ and should be reduced by the original 2△, leaving 1△ base in before each eye.

The patient now sees one cross. Inquire which is clearer and blacker, the horizontal or vertical lines.

In the binocular check, if the horizontal lines are blacker, add plus sphere in equal amount to both eyes. If the vertical lines are the blacker, add prism, base in, equal amount to both eyes. The purpose of prism base in is to hold the convergence in check and permit the accommodation to remain relaxed, so that the full plus correction can be worn with comfort and clear vision. Add base in prism until all lines are equally blurred.

In myopia, insert at once one-third of the distance abduction as prisms base in. If the vertical lines are still blacker, use enough minus sphere to make all lines equally blurred. In low accommodative, or pseudo, myopia, say up to 1.50 or 2 diopters, usually the full convergence relaxation can be developed at the first sitting, so that a permanent prescription of prism base in can be given, leaving the eyes in their normal condition of emmetropia with exophoria. Convergence relaxation exercises with the Kratometer can often be carried on so successfully that the association of accommodation and convergence is completely broken down. Then that first prescription of base in prisms can be reduced, little by little, until the patient no longer needs glasses, but is emmetropic with normal vision, convergence and accommodation functioning efficiently and in co-ordination but without synergistic association.

Or, if the true condition is a slight hyperopia, the relation of convergence to accommodation can be so modified by this treatment that the true plus correction can be worn.

Always, the cross-cylinder check, used binocularly, will show the relationship of convergence to accommodation and will reveal which of the two is being used in excess. When the horizontal lines are the blacker, accommodation must be re-

pressed with plus spheres. When the vertical lines are clearer, convergence must be repressed by base in prisms.

In myopia, if minus lenses must be given for distance wear, always make the binocular cross-cylinder check at the reading distance. If the horizontal lines are clearer, add plus to equalize horizontal and vertical, and prescribe bifocals regardless of age. This to prevent all possibility of the inception of progressive myopia. Give convergence relaxation exercises with the Kratometer, until the first reading correction is finally accepted for distance wear with clear vision. Probably, but not always, some base in prism will need to be incorporated in that prescription.

In esophoria, if this condition persists after the correction has been determined by the usual methods, turn at once to the Kratometer and Chart No. 2, using base down and base up prisms from the rotary disks to produce two images of the cross. If there is no exophoria at the usual reading distance, draw the card nearer to the patient, until an exophoria becomes manifest. Then proceed as above directed, inserting sufficient base in prism from the horizontal slides to correct this manifest exophoria, then adding plus spheres to both eyes to equalize the blur on both crosses. Then turn out the vertical prisms, so that the patient sees but one cross. Set the card at the reading distance, if the test was made nearer than that point, and reduce prism and sphere to equalize the appearance of the lines, always leaving in as much plus as possible and utilizing the prism to hold the convergence and associated accommodation in check.

Then set the card at the extreme outer end of the reading test rod, and again reduce. Then place Chart No. 1 at about 2 meters and once more reduce until the lines are equally blurred. Then retire the Chart to 3 meters and reduce, then to 4 meters, then to 5 and 6, and so on, to the extreme length of the room. This procedure will leave much more plus in place than the old system of "fogging" with re-

ductions direct from an empirically chosen plus down to that lens accepted for clear vision of the distance test chart.

If the full reading correction for the non-presbyope, as determined by the cross-cylinder test, is not at once accepted for distance accommodative orthophoria with clear vision, and if with the lenses accepted for clear vision some esophoria still persists, prescribe bifocals, regardless of age. These bifocals may well contain prism base in elements in the reading segments. Give convergence relaxation exercises until the original reading correction is worn for distance with clear vision. It may happen that the final distance glasses, for a person who at first showed esophoria, will contain prism base *in* for constant wear. The cross-cylinder test can be depended on to show if these repressive prisms are necessary.

Sectional astigmatism is shown when either vertical or horizontal lines persist in appearing blacker regardless of the amount of sphere or prism added. Give Kratometer exercises in convergence relaxation until the full astigmatic correction as indicated by the ophthalmometer is accepted.

Jewelers, die-cutters and many other workers who must hold their work at eight or ten inches, will always need some base-in prism in their working glasses. For the repression of the accommodation effected by the strong plus needed for clear vision at so near a point will destroy the balance between accommodation and convergence. The exact amount of this prism is shown by the cross-cylinder test used with the Kratometer. First find the reading correction at 35 cm., then draw Chart No. 2 forward to the mark on the reading rod corresponding to the distance at which the subject must work. The vertical displacing prisms from the rotary disk are turned in, as previously described, and at once considerable exophoria will be found. Correct this with prisms from the horizontal slides so that the two crosses are directly above each other, insert the proper cross-cylinders, and the horizontal lines will come out black. Add sufficient plus

sphere to make all lines equally blurred for both eyes. Turn the vertical prisms out, leaving the rotary disks at open. But one target is now seen. Adjust the prisms of the horizontal slides until all both horizontal and vertical lines are equally blurred.

All hyperopes needing above +4.00 D. for distance vision will need a bifocal addition for near work. This is because the difference in lens effectivity for near and distance vision becomes noticeable at about +4.00 D. The amount of this addition can be figured out with a long mathematical computation, but this is unnecessary to the possessor of the Genothalmic Kratometer. Use Chart No. 2, with the proper cross-cylinders, and the correct addition is found in a moment.

Cross-cylinder test lenses for use in the front lens cells of the Genothalmic Kratometer will be furnished at $8.50 for the full set of four pairs enclosed in a convenient case. In ordering, specify diameter, whether 1½ inches or 1¼ inches.

DIFFERENTIAL DIAGNOSIS AND TREATMENT

THE DYNAMIC DISTANCE PHORIA TEST

THE dynamic accommodative phoria test at distance must be one of the first steps in a well ordered refractive examination, for this is the guide to all subsequent procedure and is the key to a binocularly balanced correction. The findings of this test show the point to which the associated, synergistically innervated, accommodative-convergence impulse brings the pair of eyes, the point at which accommodation and convergence dissociate and henceforth act independently.

Hence, the test must call forth the act of accommodation. For this reason, Chart No. 1 should be so mounted that it can be moved to different distances from the patient. If the vision is so poor that the chart cannot be seen, move the chart within the range of vision. If one eye is decidedly poorer than the other, but is a functioning eye, favor this eye by

bringing the chart near enough to call this eye into action. (Page 20.)

Since we seek information as to the visual habits of the patient, this first test is to be made without glasses, or, if the patient is already wearing glasses, it is to be made with the old correction in the rear cells of the Kratometer. (Pages 19-20.)

Comparison of the distance and near phoria tests will give information of considerable value, as is discussed in the following pages.

As a routine, use displacing vertical prisms, base down over the left eye and base up over the right eye. (Pages 19-20.) Use as little prism as possible, but make sure that the two crosses are definitely separated, that is, that they do not merge into each other. There is less confusion if they are not thrown too far apart.

Occasionally, vertical ductions are so high that an inordinately great amount of prism must be used to obtain vertical diplopia. Try the prisms in reversed position, base up over left and base down over right. If this is done, remember that the positions of the crosses are reversed from those used in the text. (Page 21.) This is the first warning of a possible hyperphoria and inequality in vertical ductions.

The fixing, or dominant eye, will hold one of the images on its macula, and refer the position of the other from this fixation point. If the lower image belongs to the right eye, and the right eye is the fixing eye, the upper image is off the macula of the left eye. It is then easier to the patient to think of the upper image as being to the right or left of the lower. But if the left eye is the fixing eye, it will hold its image on its macula while the right eye's image is in the indirect field. Such a person will always speak of the lower image being to the right or left of the upper image. The refractionist must always be able to conform his mental attitude to that of the patient, to think in the patient's terms.

If one cross seems to waver, so that the patient cannot tell exactly where it is, this indicates an uncertainty and unreliability of nervous innervation. At once, we may expect to find poor ductions and poor motility. In these cases, try to find out the tendency of the wavering, is it toward an esophoria or toward an exophoria?

Many times, an orthophoria is first indicated, which suddenly becomes an exophoria, then jumps back to orthophoria again, may remain there, or may switch back and forth. Suspect exhaustion, from either uncorrected hyperopia or a true convergence insufficiency.

NEAR PHORIA TEST

Use Chart No. 2. Set at 35 cm. Procedure (pages 23-25) is much the same as in the distance phoria test. Comparison of distance and near phorias is of value in analyzing the case.

ESOPHORIA

Compare chart reading with amount of prism, base out, required to vertically align the two images. (Pages 21-22.)

Take distance abduction, which will tell the patient's ability to care for the esophoria. (Pages 27-29.)

Turn at once to the problem of near correction, without wasting effort on the distance tests. Work out a tentative correction with the dynamic retinoscopic and subjective methods. Note that in severe cases of esophoria, the shadow movement is often "against," although the needed correction is plus. With this tentative correction in the rear cells of the Kratometer, proceed to develop, or unlock, the full correction with the cross-cylinder methods. (Pages 76-82.)

Correct the corneal astigmia with plus cylinders before attempting to determine the static spherical defect. (Pages 69-71.)

Take abduction at reading distance, make note of amount. Relax convergence with base in prisms and uncover the full latent error. (Pages 78-79.)

Remove all prism, and ascertain by the cross-cylinder method whether or not the full correction can be worn at the reading distance. If the vertical lines of the chart are blacker than the horizontal, either the plus must be reduced or base in prisms given or both. But make every effort to keep on as much plus as possible for the reading distance.

Before reducing the plus, test how much base in prism is required to make both horizontal and vertical lines equally blurred. In stubborn cases of esophoria, it is always advisable to give bifocals, regardless of age, and some base *in* prism can be wisely incorporated in the segments. Not more than one-third of the abduction at reading distance can be tolerated in the segments. Give as much plus as can be crowded on at the reading distance with this amount of prism, leaving horizontal and vertical lines slightly but equally blurred. (Page 77.)

Reduce to give clear distant vision (page 82). If the retention of some prism will permit the wearing of more plus than can be tolerated without that prism, it is advisable to prescribe a little base *in* prism for constant wear. Not more than one-third of the distance abduction can be tolerated for wear. And these glasses are temporary only, for the constant use of base in prisms will destroy stereoscopic vision.

Give daily Kratometer exercises in convergence relaxation. (Pages 51-54). As the association of convergence and accommodation breaks down, more plus can be added to the distant correction, and sometimes to the near addition as well. Eventually, in the non-presbyope, all the first addition will be incorporated in the distance correction, without blur. If the amount of abduction is increased by the Kratometer exercises, more prism, base *in*, can be added to the correcting glasses.

After the full plus has been accepted for distant vision, the prism portion of the correction can be slowly reduced. The ultimate aim of this treatment is to make the full hy-

peropic error manifest and correctible, so that the patient can wear the full plus correction with ease.

Pathological symptoms often found in esophores are indigestion, intestinal pain, chronic constipation, low blood pressure, nervous exhaustion and hysteria. These troubles resist medical treatment until the latent hyperopia is corrected.

Adduction must not be taken in any form of esophoria cases. Adduction reserve is always low, because of nervous exhaustion, but it will automatically increase to normal when the full plus correction is fitted. Never, under any circumstances, give exercises with base out prisms to esophores. This will only add to their trouble, and negative your attempts to get on the full plus correction.

If esophoria is found at distance, and no latent hyperopia is discovered, then the imbalance is not accommodative esophoria, but is due to lack of control in the central nervous system. This may have been caused originally by some disease. Give daily exercises in convergence relaxation (pages 51-54). Often the temporary prescription of weak base in prisms, not more than O. U. 1 △, will prove helpful. These to be worn for an hour or two a day. Continue these treatments until the esophoria is decidely less, the response to abduction prism jumps is quick and troublesome symptoms have disappeared.

Esophoria at both distance and near would indicate (when not toxic) a high latent hyperopia with a strong nervous reserve.

Esophoria at distance with considerable exophoria at near (pages 24-25) indicates a high latent hyperopia with an exhausted nervous system.

Esophoria at distance with convergence insufficiency at near (F - I. test, pages 38-39), indicates a high latent hyperopia with an exhausted nervous system.

Esophoria at distance with convergence over-innervation at near (F - L test, pages 38-39), indicates a high latent hyperopia with a highly driven nervous system. The ultimate result, if the latent error is not corrected, will be nervous exhaustion with convergence insufficiency.

In accommodative esophoria, the structural requirement of convergence is less than the requirement of accommodation, but convergence and accommodation are rigidly associated, dissociation being extremely difficult. The esophore is invariably of the strong-willed, dominating type, energetic and masterful. No type of imbalance is so difficult of correction as this, and the patience and resourcefulness of the refractionist will be tried to the utmost in overcoming the control of convergence over accommodation and rendering the latent error correctible.

ACCOMMODATIVE ORTHOPHORIA

Correction of any manifest hyperopia may or may not give comfort. A finding of accommodative orthophoria at either distance or near is no proof of convergence sufficiency.

Occlusion of one eye may, in some cases, relax some of the convergence and permit monocular correction of at least part of the error. In other persons no convergence relaxation will follow monocular occlusion.

If plus lenses fitted monocularly should binocularly alter a previously existent orthophoria to an exophoria, either the plus must be reduced or base in prisms prescribed, temporarily, to the amount of this created exophoria. This is evidence of considerable latent error. Disclose this in full (pages 78-79) and treat the case by the same methods as outlined under the treatment of esophoria.

If there is no considerable latent error, and the patient complains of discomfort at near work, take the adduction at the reading distance (pages 26-33). If this makes a poor showing, exercises with base out prisms are in order.

Accommodative orthophoria at distance with not more than 4△ exophoria at near is a normal condition.

Accommodative orthophoria at distance with esophoria at near indicates a high latent hyperopia and a strongly functioning nervous system. The full error must be made manifest and corrected by the same methods as are used in esophoria cases.

Accommodative orthophoria at distance and over-innervated convergence at near (F - L test, pages 38-39), indicates a high latent hyperopia, similar to the immediately preceding paragraph.

Accommodative orthophoria at distance with convergence insufficiency at near (F - L test, pages 38-39), may indicate either a true convergence insufficiency or an insufficiency from exhaustion due to an uncorrected latent error. The distinction is to be made by the amount of latent hyperopia found (page 79-80).

Accommodative orthophoria at distance with high exophoria at near may indicate either true convergence insufficiency or a high latent hyperopia, as in the preceding paragraph.

Pathologic symptoms in cases of accommodative orthophoria with high latent hyperopia are about the same, but with less severity, as in accommodative esophoria. The latent error, however, is more easily made manifest and correctible.

The manifest need of +0.50 to +1.00 D. spheres for near work by young people with orthophoria at distance and either orthophoria or exophoria at near, when there is no high hyperopic error discoverable, is due to exhaustion because of convergence insufficiency and the extra nervous effort used in converging. Give exercises to develop the function of convergence; do not prescribe "rest glasses." (Pages 55-60.)

Accommodative orthophoria at distance in presbyopes where the addition of the needed presbyopic correction in-

creases the exophoria at near. This is evidence of an uncorrected latent hyperopia. This must be made manifest and corrected by the same methods as are employed in esophoria.

In myopia with orthophoria, minus lenses must not be given so strong that the orthophoria is lost and esophoria established, for progressive myopia will develop rapidly.

EXOPHORIA

Accommodative exophoria at distance with the same amount, or 1△ to 4△ more, at near, is a normal condition. Compare chart reading with amount of prism, base in, required to vertically align the two images. (Pages 21-23.) Sometimes, the discovery that more prism is needed for this alignment than the chart scale indicates may be considered as evidence of a latent hyperopia that should be uncovered and corrected.

Exophoria at distance with considerably more at near, i. e., 5△ or 6△ or greater amount of difference, may be due to any one of four distinct causes: (1) Uncorrected latent hyperopia; (2) true convergence insufficiency; (3) hysteria; (4) neuritis and toxemia from focal infections. The first is to be treated by uncovering and correcting the latent error (page 79); the second is determined by failure to discover a noteworthy latent error, and is treated by base out exercises (pages 55-60); and exercises in motility (pages 61-64); the third and fourth are to be given proper medical treatment before attempting direct corrective measures (page 61).

Exophoria at distance with convergence insufficiency at near (F - L test, 38-39) bears the same interpretation as high exophoria at near described in the preceding paragraph. Note that often the F - L test shows an insufficiency that is not revealed in the phoria tests.

Exophoria at distance with less exophoria at near; with orthophoria at near; with esophoria at near; any of these indicates an uncorrected hyperopia with a strong and, as yet, unexhausted nervous functioning. Exhaustion and con-

vergence insufficiency will surely follow if the latent error is not brought to light and corrected.

In exophoria with hyperopia or with presbyopia, if the correcting lenses increase the exophoria, special attention must be given to the case. Either the plus must be reduced or base in prisms to compensate for the increase must be prescribed. Usually, still more hyperopia can be uncovered with Kratometer relaxation exercises and the cross-cylinder method. (Pages 77-79; 51-54.)

Exophoria from exhaustion, at either distance or near, will grow less or disappear entirely when the hyperopia is corrected.

In cases of exophoria with complaint of ocular discomfort at near work, if no more than 0.50 to 1.00 D. of manifest or latent hyperopia can be discovered by the most searching methods (pages 78-80), we may suspect true convergence insufficiency and careful study of adduction reserves is to be made (pages 29-34; 37-41). The essentials of adduction reserve are: (1) Amount of base out prism overcome without diplopia; (2) Ability to quickly regain single vision without much reduction of prism power after the break occurs (the true reserve is the amount at which fusion recovers); (3) Freedom from fatigue after several repetitions of the adduction test; (4) Speed, or the ability to overcome rapidly succeeding prism jumps without falling into diplopia.

Failure to make good showing in these adduction tests may be considered as evidence that exercises for increasing the convergence reserves will be beneficial (pages 55-60). Also exercises with stereo-cards (pages 45-50) and exercises in motility (pages 61-64).

As in orthophoria, the apparent acceptance of weak plus lenses for near work only, by young people, when there is no latent hyperopia of serious amount, is evidence of accommodative exhaustion from over effort in forcing convergence.

Exercises for development of the function of convergence (pages 55-60) are preferable to the prescription of glasses.

In speaking of hyperopia with exophoria, in the above paragraphs, we refer to both spherical and astigmatic errors. The effect on phorias and ductions of an uncorrected astigmatism is in all essentials the same as an uncorrected spherical error.

In myopia with exophoria, minus lenses must not be given that will *decrease* the amount of the exophoria, for this would surely bring on progressive myopia.

Accommodative exophoria, in itself, will cause no discomfort. But if it is increased, by ever so little, by plus lenses, the patient is liable to suffer no inconsiderable annoyance, a feeling of strain, blurred vision, watering eyes. The same symptoms will follow the prescription of minus lenses that decrease the normal accommodative exophoria.

Accommodative exophoria is distinguishable from exhaustion exophoria by the fact that the latter is decreased by plus lenses, while the former is increased by plus corrections that are binocularly too strong, although they may be monocularly correct.

MYOPIA

In myopia, relax the convergence by Kratometer exercises. Take the distance abduction and prescribe, for constant wear, base *in* prism of not more than one-third the amount of the abduction, together with such plus cylinders and minus spheres as may be needed for the full correction of the astigmatism and clear vision, provided that this correction does not establish an esophoria nor change a pre-existing orthophoria or exophoria. This procedure will usually reduce the amount of minus sphere needed.

Sectional astigmatism is very commonly found in myopia, and the corneal error must always be properly neutralized by plus cylinders. (Pages 69-71.)

In more than half the cases of myopia, proper Kratometer

treatment by convergence relaxation exercises (pages 51-54), will materially reduce the minus correction.

In children and young people in whom myopia is just commencing to appear, the myopic condition can be broken down and the patient returned to emmetropia with clear vision, by breaking down the association of convergence and accommodation with base in prisms and Kratometer relaxation exercises.

Never, under any circumstances, take the adduction of, or give base out exercises to, myopes.

Most myopes need bifocals. The amount of the addition is determined by the cross-cylinder test. Frequently, the use of base in prisms and convergence relaxation exercises will bring about clear distant vision with what at first seemed the reading correction.

Always, as the first step, and before determining the correction that will give clearest distance vision, relax the convergence and ascertain the true static error (pages 77-79). Make every effort to bring about a condition in which this correction of the true error can be worn for distance vision. The procedure is the same as already outlined for the treatment and full correction of latent hyperopia. (Pages 76-82.)

Convergence relaxation and dissociation from accommodation will increase the range of clear vision for myopes, even though the minus correction is not very greatly reduced.

Kratometer treatment will prevent the onset of progessive myopia.

HYPERPHORIA

In persons of advanced age, manifest hyperopia is usually evidence of neuritis from focal infections. Neuritis (nerve toxemia) is characterized by inability to control muscles and functions that are normally associated. Such cases arise from infections from decaying teeth and tonsils, sinus troubles, auto-intoxication, high blood pressure, etc., and are

to be given medical treatment only. Prism wearing and prism exercises are useless.

In healthy persons, tendencies to hyperphoria can be reduced by Kratometer treatment. (Pages 26; 34-37; 41; 42-44; 65-68.)

Many apparent hyperphorias are caused by imbalance between convergence and accommodation with frantic efforts on the part of the central nervous system to bring about single vision. Therefore, always bring accommodation and convergence into equality of requirement before making final decision as to a manifest hyperphoria. Vertical ductions are always to be made with the full correction in place.

Cyclophoria presents the same manifestations as does hyperphoria, and is often due to the same causes. Give Kratometer exercises in motility in all directions, including exercises with the prism slides at oblique angles. (Pages 67-68; 61-64.)

ASTIGMATISM

Headaches from astigmatic error are usually due to (1) Meridional contraction of the ciliary (Sectional Accommodation) in compensation of the corneal error; (2) Continual alteration of focus from the meridian of highest curvature to that of lowest curvature and vice versa, with consequent continual readjustment of convergence relations to accommodation; (3) Impaired conductivity due to toxemias, so that unequal innervation in various meridians is supplied to the ciliary with resultant fatiguing effort to adjust for clear vision.

The latter condition requires medical as well as refractive treatment. In the first two, Kratometer treatment will assist in getting on the full cylinder corrections and bringing relief (pages 69-71).

ESOTROPIA AND EXOTROPIA

Esotropia is caused by an undue effort to compensate for a

high hyperopic error. It is frequently brought to a climax by some irritation in the visceral region leading to a spasm. Every effort should be made to learn the time and origin of this spasm. Sometimes, the very effort of accommodation to maintain clear vision through prolonged fixation is sufficient to bring on the esotropia without the visceral irritant. This latter cause has been known to produce temporary esotropia in adults up to the age of fifty who have refused to wear correcting lenses.

Since the greatest accommodative strain is at the near point, and full correction for near will blur distant vision, bifocals should always be given, regardless of age. The cross-cylinder test can usually be used with quite young children, for they are able to distinguish between the lines that seem best and those that are dim. Reversal of the cross-cylinders, turning the plus axis to 90, with consequent reversal of the blacker lines, will prove whether the child is telling the facts or merely guessing.

If the eye turns straight in, or in and down, usually the squint can be corrected with lenses and Kratometer treatments. If the eye turns in and up, it is not a case for refractive treatment.

Intermittent exotropia is caused by intermittent visual fixation, or suspenopsia. It is to be cured by Kratometer treatment, using Charts Nos. 3, 4, 5, 6, 7, 8, 9 and 10. Frequently, true hyperphoria accompanies intermittent exotropia, and should not be corrected by "prisms in position of rest," for these will tend to make matters worse, but by reversed prisms, as described in pages 65-67.

Considerable discretion must be exercised in fitting the refractive error. Full plus corrections can never be given. Minus lenses, in low hyperopia, will often be found advisable, for these incite the accommodation and thus call forth all associated functions of attention, fixation, convergence and fusional desire. Such minus corrections are temporary only,

and are to be decreased in strength from time to time as progress warrants.

Permanent exotropia may result if the habit of suspenopsia is not corrected. If the eye has not become amblyopic from disuse, the prognosis is favorable. Treatment is the same as for the intermittent type. If the eye has become amblyopic, use Chart 11 and the methods described in pages 74-75.

If the eye turns out and down, it is not a case for lenticular aid or prism exercises. If the eye turns out and up or straight out, properly applied lenses and prism exercises will usually be successful.

SUSPENOPSIA AND SUPPRESSION

Suspenopsia, intermittent visual attention and fixation, is a vestigial trace of the visual habits of those primordial animals who use alternating monocular vision. It is never found in esophoria, rarely in orthophoria, but is quite common in exophoria. It is corrected quite readily by Kratometer treatments, which attract attention by the jumping image appearing suddenly on the field of indirect vision. The correction of suspenopsia is merely the education of the visual centers in remaining attentive. (Pages 45-50.)

Suppression is nature's method of avoiding strain. It is very common in esophoria, very rare otherwise. It is to be cared for by the full correction of the hyperopic error, and Kratometer treatments with base in prisms, creating the ability to maintain fusion of the two images without strain or fatigue. It is always wiser to use the Kratometer as a stereoscope with the special cards Nos. 3 to 10, for only in this way may the operator be sure that suppression is not occurring.

In suppression, cling closely to base in prisms. In suspenopsia, exercise with both base in and base out effects. In both troubles motility and speed of adjustment are poor. After the habit of intermittency is fully and surely corrected,

give the exercises in motility and speed of adjustment outlined in pages 61-64.

DIZZINESS

Dizziness, car-sickness, fatigue at the movies, eye-fatigue from motoring, are due to slow motility and slow adjustment. Where there is a high latent hyperopia, speed of adjustment is almost always slow, especially in esophoria. Full correction of the error will automatically release the energy required for speed of adjustment.

In slow adjustment, suppression often occurs. Here the suppression is due to slow neuro-muscular reflexes. In suspenopsia, slow adjustment is always present. Here the slowness is due to the imperfect development of binocularity. True convergence insufficiency, which is arrested development of the function, is always accompanied by slow adjustment ability. Build up the reserve adduction, both in amount and speed, and the dizziness and car-sickness will no longer trouble the patient.

EXERCISE PERIODS

DAILY exercises for short periods are far better than long periods spent once or twice a week. For we are training functions, educating the nervous system to proper habits. Home exercises are of little avail, save in very simple cases. The patient is not under guidance and can easily develop wrong habits in his home exercises.

Fifteen to twenty minutes daily are ample. Some individuals cannot stand that much at first. Study the patient, and conform your practices to his requirements.

The various cards are arranged in the chart holder in their logical order, so that no time is lost in changing from one to another. One or two minutes on each card, the whole series run through daily, will soon accomplish the desired results.

Many cases can be fully disposed of in two or three weeks. Stubborn and complicated cases may require as many months.

To conserve the refractionist's time, make it possible for the busy practitioner to include this work in his crowded day, insist that each patient have a definite time at which to appear for his or her treatment, and that he or she must come exactly at the appointed hour, or lose the appointment. Also, make it clearly understood that every day's treatment must be paid for even if the patient does not come to take it. In this way, regularity is secured, and without regularity nothing can be accomplished.

POSSIBILITIES OF THE GENOTHALMIC KRATOMETER

THE Genothalmic Kratometer methods educate FUNCTIONS when these are but partially developed or have become impaired. The Kratometer exercises, as outlined in the preceding pages, go direct to the root of muscular innervation as it is directed in the central nervous system. Correct and prompt innervational habits; proper distribution of innervation and inhibitions; associated control over muscles that should be synergistically innervated; quickness in associations, dissociations and regrouping of muscular innervations so vital to efficient functioning of binocular vision; reduction of time loss in the synapse; all these are made possible if the Kratometer is used thoughtfully and intelligently.

No single piece of apparatus has yet appeared that will reveal so many of the idiosyncracies of a poorly functioning pair of eyes. The refractionist is urged to cultivate a habit of keen observation, to listen with attentive mind to chance remarks of his patients, to study the abilities and disabilities of the pairs of eyes under treatment as revealed in the course

of his work with the Kratometer. For often one of these chance remarks will lead to a series of observational studies that will enable him to penetrate the mysteries of that particular pair of eyes, guide him in the development of special educational exercises particularly applicable to that particular pair of eyes, thus assuring him of success, his patient of comfort, and enhancing his reputation in his community.

BOOKS FOR SUPPLEMENTAL STUDY

Ocular Orientation. By E. H. Hazen. $3.50.
Binocular Balance. By R. M. Peckham. (In preparation.)